



**FOREIGN MILITARY SALES:  
A HISTORICAL REVIEW OF ARGENTINA'S  
PURCHASES**

THESIS

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THESIS

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### **Abstract**

Since June 1986 the Argentina Air Force maintains at WPAFB Ohio a procurement office to obtain defense articles under the Foreign Military Sales system. The aim of this thesis is to provide an historical review (1994-2012) of the procurement under FMS and bring some visibility about the procedures and get some managing indicators. The analysis considered three different aspects: the characteristics of the acquisition processes, the time in the procurement system and the relationships between independent variables and the acquisition time through a multivariate linear regression model.

The results of the analyses are as follows: the USAF Services has the shortest procurement time, 78% of all acquisition processes initiated resulted in a 92% of fill rate; 68% of all acquisitions were considered Standard; and for both Standard and Non Standard the acquisition median delivery time was around a year. Also, neither the type of the defense article, type of procurements or the U.S. Service supplier influenced the pipeline time. Only the country priority showed a slight degree of linear association with time. The multivariate regression model had an  $R^2$  equal to 0.169, showing a weak linear association between variables.

AFIT-ENC-13-M-04

*To my parents*  
*To my family*  
*To my Air Force*

## **Acknowledgments**

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Juan E. Perot

## Table of Contents

	Page
Abstract .....	iv
Dedication .....	v
Acknowledgments.....	vi
Table of Contents .....	vii
List of Figures .....	viii
List of Tables .....	x
 I Introduction .....	 1
 II. Literature Review .....	 6
Overview .....	6
The FMS inside of the Security Assistance Programs.....	8
Other aspects .....	18
 III. Methodology .....	 22
Process Characteristics.....	26
Time in the System .....	32
Regressions .....	34
 IV. Results.....	 38
Process Characteristics Analysis.....	38
Time in the system .....	50
Regressions .....	54
 V. Discussion and Conclusions.....	 58
Process Characteristics Analysis.....	58
Time in the system .....	59
Regressions .....	59
Future studies .....	63
Recommendations.....	63
 Bibliography .....	 65
 Vita.....	 66



## List of Figures

	Page
Figure 1.1. Particular Supply Chain developed between AAF and FMS .....	2
Figure 2.1. Evolution of the FMS investment FY 2001 – FY 2011 .....	7
Figure 2.2. Authorization Act since 1954.....	11
Figure 2.3. Logistics Communications – Fig 10-1 MSA 29th Edition.....	16
Figure 3.1. Document Number and its aspects relations .....	25
Figure 3.2. Status Codes in the master file .....	28
Figure 4.1. Percentages of acquisition initiated by AAF through U.S. Services.....	39
Figure 4.2. Successes, Cancellations and Back Orders purchases.....	40
Figure 4.3. Percentages of Standard and Non Standard acquisitions .....	43
Figure 4.4. Comparison of the Successes, Cancellations or Rejects and BB by type of acquisition.....	44
Figure 4.5. Comparison of the procedures by type through the years .....	45
Figure 4.6. Quantity orders with cancellations or rejected codes .....	47
Figure 4.7. Absolute evolution of the cancellation orders through the years .....	49
Figure 4.8. Relative cancellation orders through the years to the total orders.....	49
Figure 4.9. Distribution of the Delta dates by type of acquisition procurement.....	50
Figure 4.10. Distribution of the Delta dates by U.S. Services Standard process.....	52
Figure 4.11. Distribution of the Delta dates by U.S. Services Non Standard process....	53
Figure 4.12. Multivariate pairwise estimation JMP® V9 .....	54
Figure 4.13. Correlations values and the statistical significant level.....	55
Figure 4.14. Leverage plots for each variable as a regressor of the delta date .....	55

Figure 4.15. Summary of multivariate regression model JMP® V9 .....	56
Figure 4.16. The Federal Supply Classification histogram.....	57

## List of Tables

	Page
Table 2.1. Twelve major Security Assistance programs.....	10
Table 3.1. Useful Master Table cell names and explanations.....	24
Table 3.2. Document Number Format and date location in julian format.....	32
Table 3.3. Country priorities. Table 10-2 Page 10-13 “MSA 29th Edition” .....	36
Table 4.1. Quantity of acquisition initiated process by US Services.....	38
Table 4.2. Successes, Cancellations and Back Orders purchases .....	39
Table 4.3. Percentages of the orders fill rate .....	40
Table 4.4. Quantity of order corresponding to different FR percentages .....	41
Table 4.5. Orders quantities assigned to each code in the ESTDOCID cell.....	42
Table 4.6. Data code summary .....	43
Table 4.7. Quantity of orders categorized by type and Successes, Failures or BB .....	44
Table 4.8. Orders with Cancellations Rejections Codes and responsibility. "C" represents customer, AAF, while "S" represents supplier .....	46
Table 4.9. Summary of the percentage responsible for cancellations.....	47
Table 4.10. Orders by cancellation codes through the years .....	48
Table 4.11. Summary of the delta dates distribution statistics values .....	51
Table 4.12. Summary of the delta dates distribution statistics values for Standard process.....	52
Table 4.13. Summary of the delta dates distribution statistics values for Non Standard process.....	53

## FOREIGN MILITARY SALES: A HISTORICAL REVIEW OF ARGENTINA'S PURCHASES

If you cannot measure it, you cannot control it.  
If you cannot control it, you cannot manage it  
(James Harrington 1611-1677 English political theorist)

### **I. Introduction**

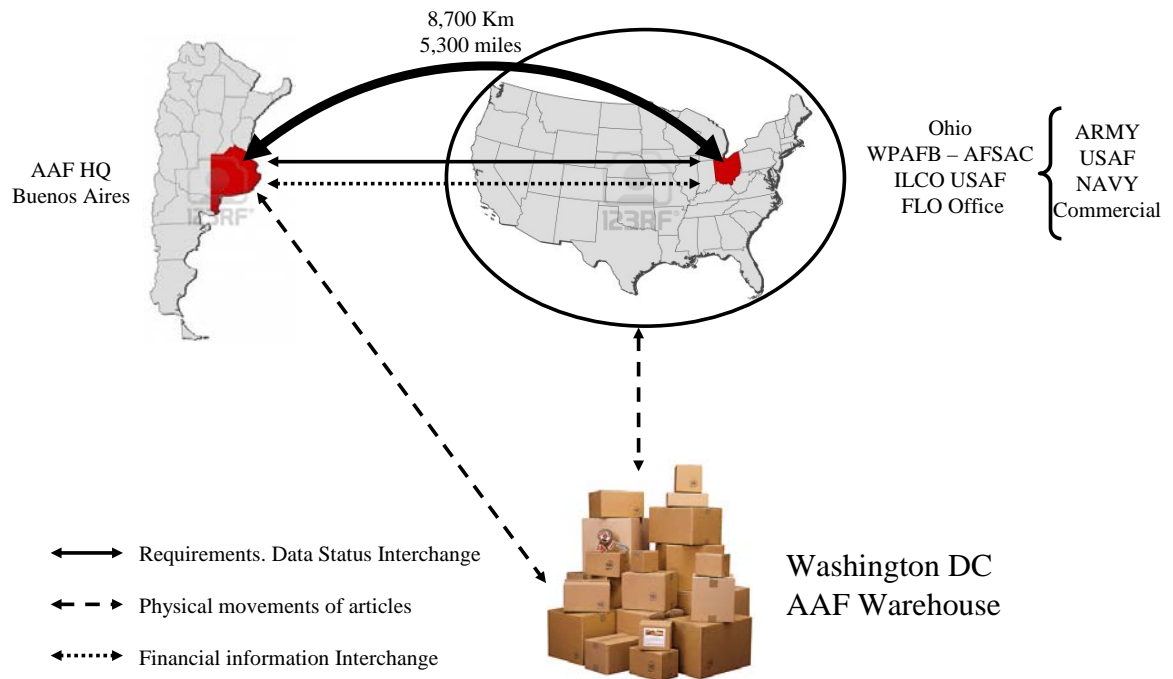
The mission of the Argentina Air Force (AAF) is: "Contribute to National Defense and acting effectively deterring interest in aerospace to guarantee and protect permanently the vital national interest". To accomplish this mission, the AAF operates daily several air and land Weapon Systems (WS). These systems require maintenance actions that allow them to maintain their availability status. Therefore, maintenance actions require the acquisition of spare parts to repair components or perform maintenance services such as overhaul, modernization, and aircraft/components upgrades.

Hence, to procure spare parts or maintenance services the AAF can choose among several suppliers according to the contractual Argentinean Republic (RA) laws. One of the ways that the AAF acquires components and services that meet their needs is through the "Security Cooperation" (SC) of the Department of Defense (DOD) programs.

The definition of Security Cooperation published in Joint Pub 1-02 is "All DOD interactions with foreign defense establishment to build defense relationships that promote specific U.S. security interests, develop allied and friendly military capabilities for self - defense and multinational operations, and provide U.S. forces with peacetime and contingency access to a host nation". One of these programs is the Foreign Military Sales

(FMS) program, which is administered by the Defense Security Cooperation Agency (DSCA) through which eligible foreign governments purchase defense articles, services, and training from the United State Government (USG). In Fiscal Year (FY) 2009 FMS is estimated to have involved around 80 foreign countries in this program (The Management of Security Assistance, 2010).

According to needs, the procurement cycle starts when the AAF generates different requirements in Buenos Aires. These requirements are then processed through the system by the Flight Liaison Office (FLO) located at Wright Patterson Air Force Base. The RA opened this procurement office approximately 25 years ago, and they manage various purchasing activities in each year for several systems. Therefore a particular and specific Supply Chain between AAF and FMS system is developed. Figure 1.1 shows a sketch of this chain.



**Figure 1.1: Particular Supply Chain developed between AAF and FMS.**

Each transaction produced during the process of the requirements is recorded in the International Logistics Communications Systems (ILCS), which serve as the primary logistics communications method for FMS. This system is capable of recording all the transactions that happen throughout the procurement process like dates, changes of status, requirements specifications, quantities, etc.

Variability and the lack of visibility in the acquisition process are the main enemies in any supply chain. Under this procurement system, it has been observed that the provisioning cycle duration is variable. As a customer we usually know the time when the requirement is placed but it is difficult to know with more or less certainty when we will receive the items. This circumstance affects in many ways the AAF's planning capability to do operations, maintenance and the next FY budget requirement as well.

The aim of this thesis is to provide an historical review of the procurement under FMS and bring some visibility about the procedures and get some managing indicators. At the end, it arrives at a series of conclusions and recommendations that are useful to optimize the use of the system, while minimizing the uncertainty in the provision of the military parts. Specifically, this research aims to answer:

- 1) What are the main factors that historically affect the procurement processes under the FMS system with respect to the AAF?
- 2) What are the characteristics of the procurements, such as, supply services, success procedures, type of acquisition, cancellations reasons, and time in the system?
- 3) What types of correlations are present that influence the procurement time?

4) What corrective actions can be applied that improve the acquisition process?

The methodology that will be used for the development of this work consists of a collection of historical information, compiling and sorting this data using the transaction records, and conducting a statistical analysis. Before performing statistical analysis, it is necessary to first understand the structure of the database and most of the codes that the system uses; this is one of the big challenges in this research. After the data is sorted, a correlation analysis can be conducted to determine the type of relationship between several variables and procurement time in the system. Finally, having the result of the previous analysis, the study will draw conclusions and/or necessary recommendations that contribute to minimize the uncertainty and improve the processes.

Usually the causes of the problems are there, and in sight and in knowledge of everyone. But, it is not until a scientific measurement is addressed that the head of the management becomes aware of how small changes generate great solutions to historical problems. Moreover, there is no previous historical analysis in the AAF regarding this topic; so it may be a milestone for future reviews. It is possible that the study leaves different opportunities for future research such as the modeling of the procurement cycle, establishing some particular metrics for the process, or further investigate the reasons of cancellations/rejections among others.

The thesis layout is as follow: In Chapter II, the literature review, we shall cover a brief explanation about how the FMS systems works in this particular supply chain and some relevant aspects that apply in procurement in an international environment and could diminish the optimal performance of the cycle. Chapter III will present in extensive detail

the methodology for conducting the research, taking into account the constraints that are made in the search for information but which in turn provide internal and external reliability and to draw valid conclusions applicable to other cases. Moreover, Chapter IV will cover the statistical analysis and assessment of the collected information and determine how to respond to the research questions. Finally, Chapter V will present the conclusions and/or recommendations.

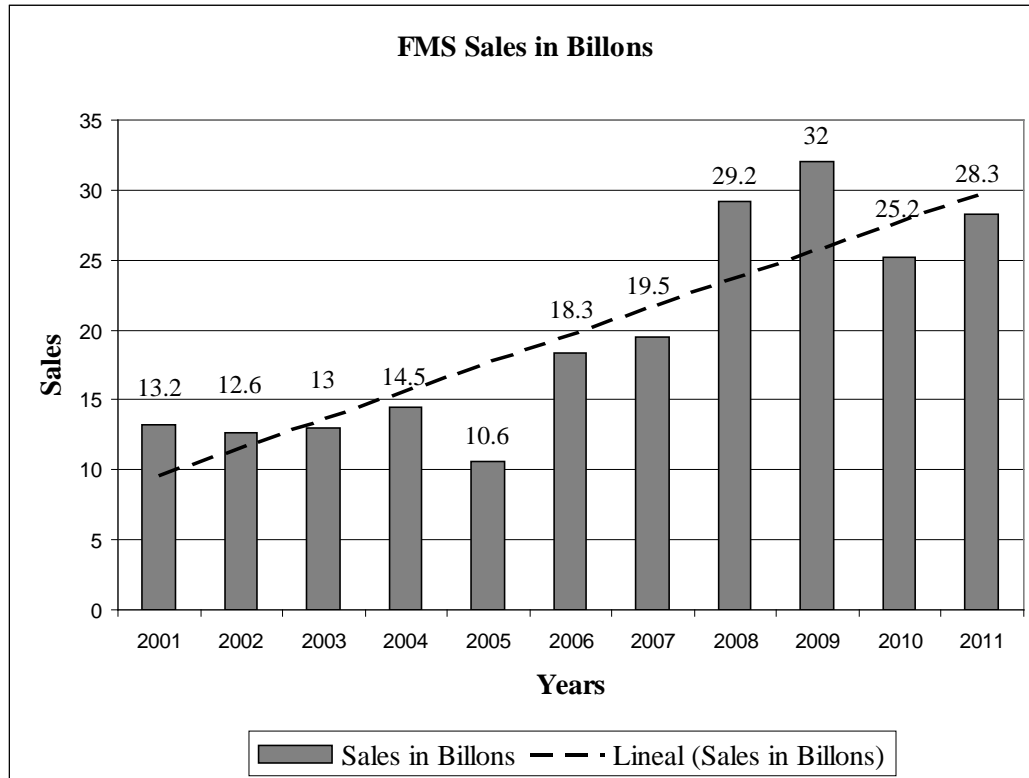


## **II. Literature Review**

### **Overview**

The same rules of the globalized world becoming smaller for access to information also apply to the business in the market of the Defense. To accompany their political objectives, a country that defends its borders and interests need to own military equipment ready to use. Operation of these systems produces natural wear and the necessity to recover their operational status. So, the demand of acquisition for military maintenance components, services, and appropriate personnel training arise.

Moreover, in the same way that all the countries don't produce all the products that they need the possibility of trade appears. It is possible to distinguish the countries that naturally are producers of military equipment and which allies satisfied their requirements from the excess of production. One of the bigger Free World's suppliers is the United States (U.S.); in 1980 the purchase orders for armaments were \$16 billion, almost 10% of all U.S. exports. In the more recent years from 2005 to 2009, the amount of FMS signed agreements went from under \$10 billion a year to over \$30 billion (DISAM Annual Vol. 1 May 2012 page 162). Figure 2.1 shows this growth.



**Figure 2.1 Evolution of the FMS investment FY 2001 – FY 2011**

This generates a considerable market for the exchange of defense goods and services. Defense goods in this case, according to the International Traffic in Arms Regulations (ITAR) 1981, are an Article or Defense Article that falls under the enumeration of Part 121 (e.g. munitions, aircraft, vessels, explosives, components, accessories, etc). It also includes any item which does not itself have direct military application but which transmits technical data relating to an article (e.g. mock ups). Defense Articles and Defense Services can also mean technical assistance, articles, services and technical data relating to articles and services.

The RA has a requirement for defense articles and is a consumer of these types of products in general to support their defense capabilities against external threats to the National Territory, support the society in natural disasters or participate in United Nation (U.N.) missions. Particularly, AAF needs to support and to maintain the military equipment where most of them are U.S. origin. This also includes the training of technical personnel. So, annually the AAF initiates the procurement of military goods and services that contribute to the availability of the materiel in ready to use condition.

### **The FMS inside of the Security Assistance Programs**

There are many aspects to analyze in the FMS system. So in the following pages, this study highlights what is considered most important and has some relations over the topic. These explanations serve as a reference to understand how the process works. Most of those concepts are from the “The Management of the Security Assistance 29<sup>th</sup> Edition” (MSA 29<sup>th</sup> Edition).

Since WWII, Security Assistance (SA) has become a continuing program used to achieve U.S. foreign policy and national security objectives in the world. U.S. recognizes that the countries need a valid defense requirement. These requirements for many allied countries usually are very difficult to fill because of the complexity of the products, economical costs, or lack of science applied to develop military equipment. Consequently, U.S. facilitates the common defense by entering into international arrangement to produce cooperative exchanges like data, research, production, procurement, training and logistics.

U.S. has the policy to achieve international peace and security through the U.N. So, armed forces shall not be used except for individual or collective self defense. According to the “The Management of Security Assistance – DISAM – 29<sup>th</sup> edition”, the only reasons to sell articles or services defense are for internal security, legitimate self defense, preventing proliferation of weapons of mass destruction, participation in U.N. activities, and supporting economic and social development activities in less developed countries. There are similar reasons in the “1976 Sec 4 Armament Export Control Act (AECA)”.

The recent development of Security Cooperation (SC), which includes SA programs, is broadly defined as: “All DOD interactions with foreign defense establishments to build defense relationships that promote specific U.S. security interests, develop allied and friendly military capabilities for self defense and multinational operations, and provide U.S. forces with peacetime and contingency access to a host nation” (Joint Pub 1-02 of 9 June 2004).

The SA is managed by the Department of State (DOS) and the Department of Defense (DOD). It has twelve major programs available to foreign countries in order to make purchases of their military needs. By law, the Secretary of State is responsible for the continuous supervision and general direction of the SA programs. Annual SA demand on the military supply systems have grown to nearly one million requisitions per service. Table 2.1 lists the names of those twelve majors programs and who is responsible for the administration.

Seven of these Foreign Assistance and Arms Export Controls are administered by DOD, specifically by Defense Security Cooperation Agency (DSCA); the others fall under general control of DOS. Also the FMS and Direct Commercial Sales are fully funded by direct cash of the purchasing countries. Therefore, these activities do not require congressional budget authorizations or appropriations.

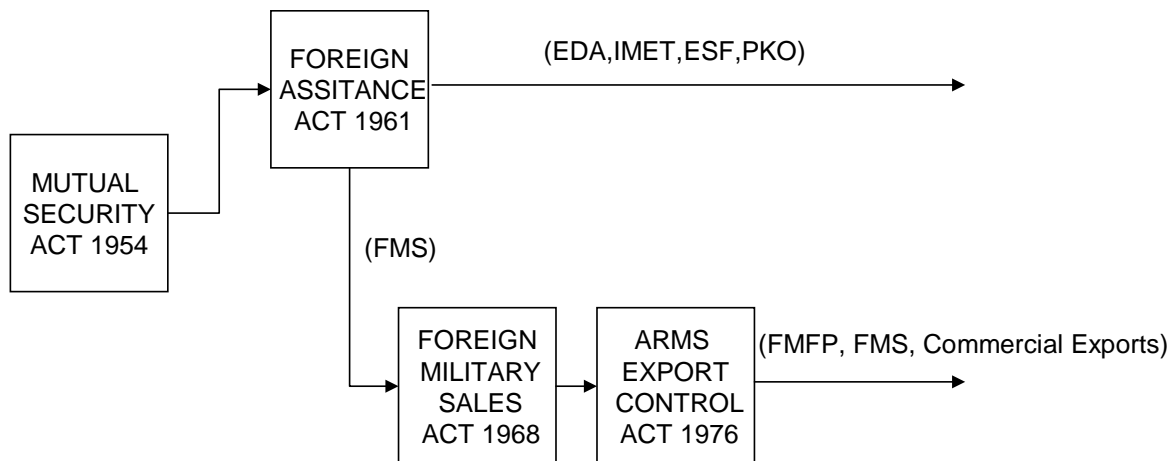
**Table 2.1 Twelve major Security Assistance programs**

#	Major Programs Names	Acronyms	Administered by
1	Foreign Military Sales	FMS	DSCA
2	Foreign Military Construction Services	FMCS	DSCA
3	Foreign Military Financing Program	FMFP	DSCA
4	Leases		DSCA
5	Military Assistance Program	MAP	DSCA
6	International Military Education and Training	IMET	DSCA
7	Drawdown		DSCA-DOD
8	Economic Support Fund	ESF	U.S. Agency for International Development
9	Peacekeeping Operations	PKO	DOS
10	International Narcotics Control and Law Enforcement	INCLE	DOS
11	Nonproliferation, Antiterrorism, Demining, and related Programs	NADR	DOS
12	Direct Commercial Sales	DCS	Directorate of Defense Trade Control (DOS) – ITAR
Other SAP	* Excess Defense Articles * Third Country Transfers	EDA	

Respect to the current U.S. program, two basic laws are involved, and both may be amended by annual or biennial security assistance or foreign assistance authorization acts. Those two laws are:

- a) Foreign Assistance Act of 1961 (FAA)
- b) Arms Export Control Act (AECA)

Figure 2.2 shows these acts and which applications fall within each.



**Figure 2.2 Adaptations from Figure 2-1 MSA 29<sup>th</sup> Edition.  
Major Security Assistance -Authorization Act Since 1954**

In general the AECA authorizes two ways in which a country or international organization may purchase U.S. defense articles, services or training:

- a) FMS: Government to government contract or LOA Case.
- b) DCS: Allowing purchasing directly from US industry with an export license issued by the DOS.

Likewise, the DOD has identified areas where U.S. origin technology and other sensitive information should be rigidly protected. The decision whether classified military information will be released to a specific country is made case by case in order to maintain the integrity of the U.S. defense. Also, there is a possibility to lease defense articles in DOD stock if the President of the U.S. determines there is a compelling foreign policy and national security reason to provide articles in leasing condition instead of sales, and that elements are not used during this time for public use. In this case, the receiving country agrees to pay all costs including depreciation and replacement costs.

The FMS process is an acquisition process where a foreign country or international organization identifies a need for a military item or service and chooses to purchase from the U.S. Government (USG). Under FMS, there is a signed government to government agreement documented on a letter of offer and acceptance (LOA). In 2009, 80 countries and organizations were part of the program. Each LOA is referred to as a “CASE” and a unique case identifier is assigned for accounting purposes. The LOA becomes an agreement when the customer signs it and provides the payment specified in the LOA. Each active LOA is assigned a unique case identifier, which enables both the USG and the foreign purchaser to refer to it without any possibility of confusion. The LOA is used to implement one of three types of FMS cases: a Defined Order, a Blanket Order, or a Cooperative Logistics Supply Support Arrangement. In detail those three options mean:

- a) Defined Order: The defense articles are specified and quantified (significant military equipment).

- b) Blanket Order: For a specific category of items or services (spares and repairs parts – publications – support equipment – maintenance – technical assistance - training). That is the most common cases used by AAF.
- c) Cooperative Logistics Supply Support Arrangement: It is a Blanket order but with more responsive follow on spare parts support for U.S. produced military hardware possessed by foreign countries.

Each of the military departments has its own dedicated FMS system to provide internal control and management of SA transactions. These systems are used to monitor the supply and financial performance of the implemented cases. The systems and codes of the military departments are:

- a) USARMY (CODE B): Centralized Integrated System for International Logistics (CISIL), and Program, Budget, and Accounting System (PBAS).
- b) USNAVY (CODE P): Management Information System for International Logistics (MISIL).
- c) USAIRFORCE (CODE D): Case Management Control System (CMCS), and Security Assistance Management Information System (SAMIS).

Annually, the FMS system reviews each case. This review usually involves face to face discussions to identify problems as early as possible. Since a major weapon system sale may last for more than seven years, the FMS system has milestones and metrics in order to ensure timely response. Also, the articles provided by FMS at minimum should meet the same serviceability standards prescribed to the U.S. forces; therefore the majorities of the items are new, unused or will have original appearance and function as much as possible as a result of rebuild or overhaul.



One particular condition is the term Excess Defense Articles (EDA), which is applied to U.S. defense articles which are no longer needed by the U.S. armed forces or will not have an adverse impact on the U.S. technology and industry. It is possible to sell EDA items under FMS with a price reduction of 50% to 95% of the original acquisition value for new equipment or a no cost transfer (grant). For EDA the basis is: “as is, where is”, Therefore, the customer bears any costs for repairs or modifications required to make the materiel usable, packaging, handling and transportation costs. Not all countries want to afford these risks, and requirements. Therefore, 55% of EDA offers are usually declined (MSA 29<sup>th</sup> Edition 2010, Chapter 10 page 29).

Typically, FMS system sales consist of a weapon system that DOD has already developed and produced. So, when a customer submits a requirement, the DOD can only use its current inventory for FMS demands, without negatively impacting U.S. readiness or proceed to procure the requirement by contracting with industry rather than supply from stock. As a customer this is beneficial because they receive the same benefits and protections that are built into the DOD acquisition process. In this case the FMS customer is not a legal participant in the procurement contract with the industry; the USG is acting on the FMS’s behalf. Moreover, the DOD maintains the same acquisition infrastructure established to support its own acquisition and logistics needs.

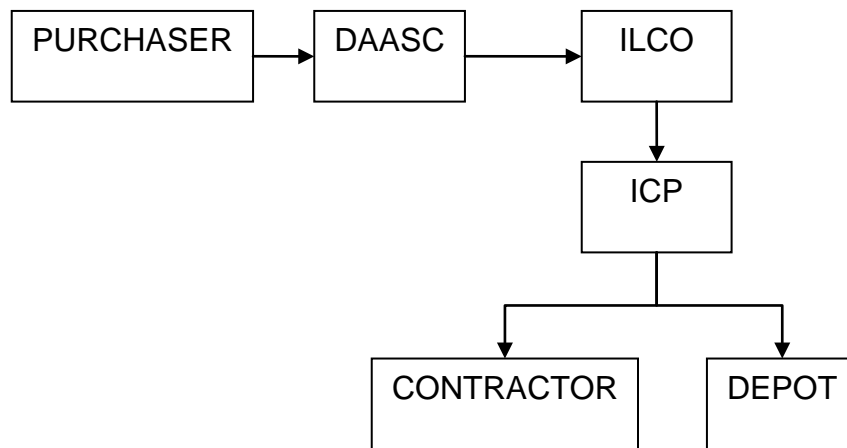
In the case that the item required will be a standard item, the requirement will be routed to the DOD inventory control point (ICP) and it will decide if the order should be supported from the stock on hand, held on back order or placed on a purchase request for procurement. However if the item is a nonstandard acquisition like systems that ended

operations but a FMS customer still continues operating like F4, F5 or A4 aircrafts, those components may transition from being standard to nonstandard and the customer usually has a minimum of two years to place a final order. In general, the Military Department (MILDEP) has contracted with commercial buying services to procure them.

The LOA standard terms and conditions reflect the preference for competition in contract awards to fulfill the requirement, but noncompetitive procurements are permitted only with a respective justification. Competitive contract awards are the default procurement method for FMS, but a FMS customer could formally request a noncompetitive procurement like a sole source (specific firm) request. If this happens, the FMS customer should have sufficient justification to demonstrate this is necessary to meet the objective needs of the customer. The most common reasons are Urgent requirement, Non standard item, Procurement history, Customer Source Selection and Standardization.

When the requisition is a blanket order, the purchaser initiates the procedure, assigns a unique document number, and passes the requirement to the International Logistic Control Organizations (ILCO, e.g. AFSAC WPAFB U.S Air Force) for each agency (Army, Navy or Air Force). The ILCO records the requisition in its database and passes to the item manager. Each electronic transaction passes through an information router, the Defense Automatic Addressing System Center (DAASC). DAASC receives, edits, and routes logistics transactions for the military services at the Defense Logistic Agency (DLA). DLA has inventory management responsibility for about 93 % of the active National Stock Numbers (NSN), (MSA 29<sup>th</sup> Edition 2010, Chapter 10 page 8).

The ILCOs are the central control point that each service has established for SA supply in order to handle the increasing annual demand of parts and to manage the requirements. Each ILCO operates a unique SA computer data system (CISIL, MISIL, SAMIS) that oversees all materiel LOAs and maintains the status of all requisitions in process and the financial status of each case. The ILCO is not a supply activity; no decision is made over supply from the stock or from procurement. That is a function of the ICPs. Figure 2.3 from MSA 29<sup>th</sup> Edition Fig 10-1, shows this process.



**Figure 2.3 Logistics Communications – Fig 10-1 MSA 29<sup>th</sup> Edition**

Successful part acquisition in logistics depends on the availability of fast, accurate and reliable communications systems. The International Logistics Communications System (ILCS) was developed (1979) to improve logistics communications to SA countries and allows a purchaser to exchange logistics information with DOD. Currently, there are 46 countries connected, (MSA 29<sup>th</sup> Edition 2010, Chapter 10 page15). Moreover, the Military Standard Requisitioning and Issue Procedures (MILSTRIP) prescribe standard form and unique codes and procedures adaptable to high speed

communications and automatic data processing with 80 record positions. One optional system within the ILCS is the Supply Tracking and Repairable Return (STARR/PC). This system provides the foreign purchaser logistics and financial information. The STARR/PC is a standard, unified interface with the U.S. FMS three services logistics system developed by AFSAC in 1988, which began to be used consistently from 1994 by FMS customers. This is the system that we used to get the data for the study and to perform analysis about the requirements transactions and their status.

One of the problems that many FMS customers face is the obsolescence or Diminishing Manufacturing Sources and Material Shortages (DMSMS) due to the fact that many of their U.S. origin systems are either in the process of, or already are, phased out of the DOD inventory. Therefore, some programs have been implemented to mitigate this issue. The Commercial Buying Services (CBS) involve the purchase of defense articles and services that cannot be effectively acquired through other means. These include:

- a) Non standard items (not included in the DOD inventory or dissimilar DOD systems configurations )
- b) Commercial off the shelf items
- c) Standard articles unobtainable within a reasonable time
- d) Others reasons.

There is no ICP assigned responsibility for managing nonstandard items; therefore manual procedures must be used to satisfy purchaser demands. This condition increases

the costs and time for U.S. and the purchaser. In general there are two special programs to use:

- a) Simplified Nonstandard Acquisition Process (SNAP) – U.S. Army
- b) Parts and Repair ordering System (PROS) – U.S Air Force and U.S. Navy.

In a large system such FMS, errors happen. In order to respond to the purchaser, the DOD recognizes this problem using the Discrepancy Report. A discrepancy is a deviation from the standard in quality or quantity. The system considers four categories of discrepancies:

- a) Transportation.
- b) Product quality.
- c) Financial.
- d) Supply, including shortage – overages – damage – insufficient remaining shelf life – incorrect item, and misdirect shipment.

The previous paragraphs have summarized the necessary knowledge and concepts of the FMS system in order to understand the research. Before concluding, we discuss some aspects that also are applicable to an international SCH and may affect its efficiency.

### **Other aspects**

In an international and government SCH where the supplier and the customer are distant and with different cultures, sometimes the classic logistics concept for a domestic SCH would not be totally effective. Communications and transports services serve as

support and make the world smaller in context where there is a permanent demand for improving delivery, lead time, cost, and product performance. The latest information and communication technologies can easily exchange information between the members, but even it is more important to improve the relationships with the members of the SCH. Additionally, RA as a third world country developing their own country logistics also involves a technological issue as well.

A military supply chain management is the discipline that integrates acquisition, supply, maintenance, and transportation functions with the physical, financial, information, and communications networks in a results-oriented approach to satisfy joint force materiel ([www.dtic.mil/doctrine](http://www.dtic.mil/doctrine)). The acquisition process under FMS system is slightly different between the military SCH and corporate organizations because the military's focus is on mission requirements rather than on quarterly earnings. This particular difference is one of the main characteristics in the military market.

However, to be successful in that kind of SCH it is necessary to have some critical factors like a solid organization, appropriate level of integration and standardization, share good level of information and have the ability to solve legal disputes. Likewise, to implement these activities will require additional training and culture changes by all members (suppliers and customers). Continuous personnel training is one of the most important issues at the moment to interact with the FMS system due to the complexity of the language that the system uses (codes) and its timeframe as well.

Additionally to achieve efficiency, modernization and improving the complexity of SCH should be necessary to diminish the barriers between the organizations. Such

barriers include: poor records, lack of prioritization (80%-20% Pareto analysis), readily available information, lack of trust, fear to share information, outdated IT systems, poor IT integration, training of personnel, weak logistic systems, different languages, and unfamiliarity with the systems. One of the most important barriers includes political and cultural differences. Adding to these inconveniences we have to consider the traditional slowdowns resulting from crossing international borders, weather conditions and human errors.

It is possible to list some aspects that lessen the effectiveness of the SCH processes:

- a) Dissimilarities: Large geographical distance, language, low visibility.
- b) Forecasting Complexities: Inaccuracy, communications difficulties.
- c) Economical and Political Worries: Risk, variability, currency exchange rates, political instability, trade barriers, bureaucracy, laws.
- d) Infrastructural Insufficiency: Shortages in telecommunications, worker skills, equipment, technology, new challenges.

However among the attributes that stand out in a domestic Logistics System (World Competitive Yearbook – Garelli 1999) and have some impact in the SCH management are:

- a) Information System in order to integrate the SCH suppliers, manufacturers, warehouses.
- b) Workers skills, and fully understanding of the system.

- c) Political environment regarding budgeting, planning and technical standards.

Likewise, performances are one of the ways to analyze the efficiency of the SCH. This is the role of measures and metrics because it affects the strategy, tactics and the operation as a planning and control tool. In turn metrics have an important role to set goals, evaluate performance and determine future courses of action (Gunasekaran 2004). A complete set of performance measures are beyond the scope of this research and could be a future line of study to improve the analysis of the efficiency in the use of the FMS system.

This chapter considered many aspects with respect to the efficiency of the SCH inside the FMS system in an international and government environment. The reader can see the volume of the Defense business and some issues that affect the visibility and control of the process mainly because of the intercultural aspects. Next, Chapter III will show the methodology to analyze the data extracted from the STARR/PC database.



### **III. Methodology**

Chapter I presented the motivation and the research questions that guide the present study. Chapter II showed a literature review conducted on some concepts regarding FMS acquisition of military articles and briefly described some factors that can affect the efficiency of a supply chain with international features, long distance and governments. Chapter III highlights the study's methodology needed to analyze the purchases made by the AAF under the FMS system and to draw conclusions that facilitate the management system at the highest level of decision.

Recall that the AAF began its activities in the Air Force Security Assistance Center (AFSAC) in Wright Patterson Air Force Base (WPAFB) in June 1986 with the opening of the purchasing office led by a Flight Liaison Officer. This office has remained in operation to date and administers the various cases that the AAF demands. Thus, each transaction that occurs during the execution of a purchase in one case is recorded in AFSAC by digital files.

The AAF, unlike other countries, uses the Supply Tracking and Repairable Return system (STARR/PC FMS Data Query and Reports). The STARR/PC produces every day a series of master files with the information received from the three agency systems, MISIL, CISIL, and SAMIS, duplicating the current status of a country's updates requisitions. Those records are then transmitted via the International Logistics Communications System (ILCS). So, a new set of records will replace the last set of

master records. Thus, STARR/PC merely updates its data bases with the same status as found in the DoD systems. Countries that have joined this system are Argentina, Brazil, Chile, Colombia, Dominican Republic, Egypt, El Salvador, Finland, France, Guatemala, Honduras, Israel, Korea, Malaysia, Mexico, Morocco, Peru, Philippines, Portugal, Saudi Arabia, Singapore, Somalia, Spain, Sweden, Switzerland, Taiwan, Thailand, Tunisia and NATO.

In this way a trained operator using the system menus is capable of tracking various queries. For example, the status of a specific requirement, to include a specific NSN, Transportation Control Number (TCN), contracts, cases, shipping discrepancies, and financial status. These menus are useful to perform specific queries but they are limited in producing an historical analysis of the different purchases status.

To perform a historical analysis it is necessary to access the data bases that feed the STARR/PC and recover the master files. The master files, in the Argentina case, have two files: a master and a master archive named MSMAST and MSMAST-ARC with the same table format. These files can be converted to a traditional Excel<sup>®</sup> format, which allows for easier data manipulation. The master table has forty five columns of data. Table 3.1 shows the columns that are of interest and usefulness in this study.

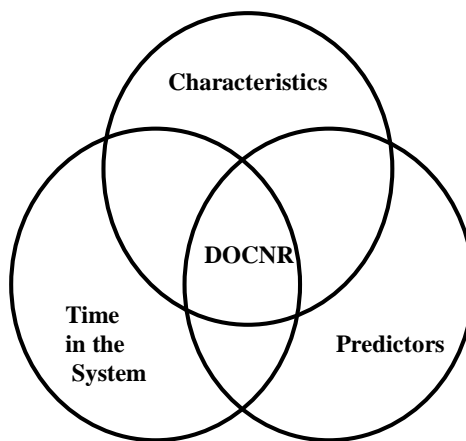
**Table 3.1 Useful Master Table columns names and explanations**

<b>Cell N°</b>	<b>Cell name</b>	<b>Explanation</b>
1	DOCNR	Document Number
2	USSERV	United States Service
3	LAST_8	Last 8 positions in the DOCNR
4	NSN	National Stock Number
5	NIIN	National Item Identification Number
6	RCASE	Case
8	PRTY	Country Priority
9	UI	Unit of Issue Codes
10	CTY_SERV	Country Service
12	FFCODE	Freight Forward Code
13	ESTDOCID	Establishment Doc ID - Document Identifier Codes
23	NMCS	Non Mission Capable Supply
24	CREQSTAT	Current Requisition STARR/PC Transaction – Requisition Transaction Status Codes
26	ESD	Estimated Shipment Date
27	DTSHIPSTAT	Date Shipment Status
28	DATENMCS	Date NMCS
29	LSTAUTODOC	Last STARR/PC Update to Document
30	LSTAUTSTAT	Last STARR/PC update to Status
31	ESTRQNDT	Establishment Requirement Date
32	UNTPRICE	Unit Price
33	REQTY	Requisition Quantity
34	CREQTY	Current Requisition Quantity
35	CQTY	Cancel Quantity
36	SQTY	Shipped Quantity
37	FFREC	Freight Forward Received
38	FFSHIP	Freight Forward Shipment
39	FFREPREC	Freight Forward Repairable Received
40	FFREPSHIP	Freight Forward Repairable Shipped
41	CNTRYREC	Country Received
42	ARCHDATE	Archive Date
43	COMPLETED	Completed
44	TRANSDTE	Transportation Date
45	PROCDTE	Procurement Date

For our study, we present a series of statistical calculations that allow us visibility to the procurement process since 1994. In the case of Argentina, the master file tables

have a quantity of 28,229 records ranging from 1994 to procurement initiated on August 2012. The analysis is focused on three different aspects that produce some influence in the DOCNR performance and their relationships. Figure 3.1 shows these relations and include the following aspects:

- a) Process characteristics: including which U.S. Services were the supplier, a magnitude of successful or failed processes, fill rate, acquisition type Standard or Non Standard, and level of cancellations / rejections.
- b) Time in the System: an analysis of the lead time of the acquisitions considering several factors.
- c) Regressions: obtaining predictors that reveal influence in the lead time of the procured articles.



**Figure 3.1 Document Number and its aspects relations**

For information on an acquisition it is necessary to process the available data. However, it is not always possible to use all records for each analysis, because there is some level of inconsistency, data entry errors or data transfer records. Despite this, there is enough valid information to draw valid conclusions in each analysis. The approach is to use as much data as possible for each case.

In general, the driver of the records is cell number 1 (DOCNR), which uniquely identifies each request that the customer makes, regardless of whether the requirement is consolidated with more than one type of requirement. This means that each requirement is assigned a single DOCNR. Moreover, in the situation that the order was cancelled for some reason and the customer subsequently enters the same requirement again it will be given a new DOCNR.

The different procedures used to perform an historical analysis are listed below and explains the method used and/or cells considered. At this point the reader may refer back to Table 3.1 that explains the meaning of each cell.

### **Process Characteristics**

- a) Percentage of processes initiated by U.S. Service: Each service, ARMY, NAVY or USAF, has a unique code that identifies each other and is registered in cell number 2 of the master file, "USSERV". The total number of procurement processes in the system consist of 28,229 records; a percentage of acquisitions initiated through each service is obtained.

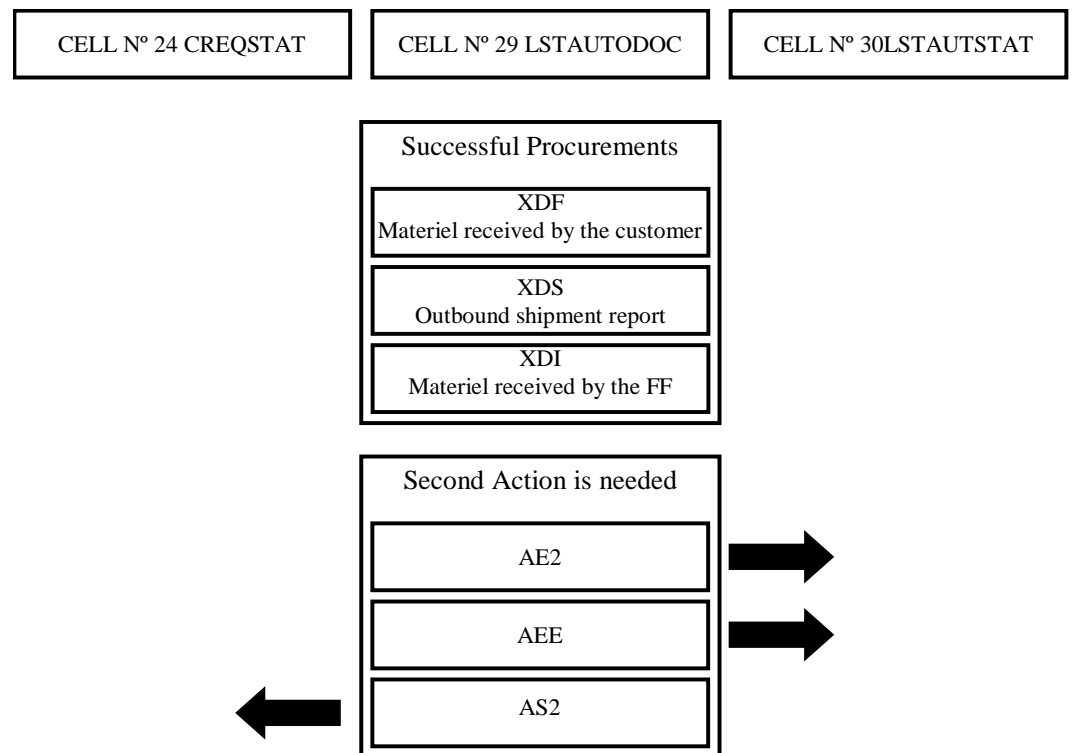
Those assigned the code “B” were initiated by the ARMY, those with “D” the USAF and those with “P” the NAVY.

- b) Percentage of successful processes versus cancellations or rejections: The status of the procurement will change along the process. Each change is reflected by a different code according to the change type. The meanings of those codes are in Appendix B Document Identifier Codes (DIC) of the Military Standard Requisitioning and Issue Procedures (MILSTRIP). In the master file those codes are recorded in cell number 29 “LSTAUTODOC”, which include the last update of the system. So, it is possible to differentiate those procedures that were successful versus those that were rejected or cancelled for any reason.

There are three codes that return direct information about successful acquisitions. Those are the codes: “XDF”, which indicate that the materiel was received by the customer; “XDI”, which indicate that the materiel was received by the freight forward; and “XDS”, which indicate an outbound shipment report. Other codes in the same cell indicate a different action, for instance the code “AE2 is used to say that a prior action is necessary to continue the supply procedure. The code “AEE” indicates a status of supply and is prepared for FMS to provide aid to the customer in the request. Lastly, the code “AS2 is a shipment status.

So, the first three codes return directly a quantity but the last three codes are necessary to disaggregated the information from another cells in order

to identify whether the procurement finally is a success or a failure. For code “AE2” and code “AEE” the cell used is number 30 “LSTAUTSTAT” which records the requisition Transaction Status Codes (18 DLA Customer Assistance Handbook 2011 edition – page 127) and assigns a status of success or failure to the procedure. While for code “AS2”, we use the cell number 24 “CREQSTAT”, which records again a Transaction Status Codes for these procedures. Figure 3.2 shows the structure of the different possibilities to these status codes on the master table.



**Figure 3.2 Status Codes in the master file**

- c) Percentage of Fill rate: Another index that can be obtained at this time is the percentage of fill rate or percentage that the orders were completed. In

this case each order shows a variation in the percentage of the fill rate between 0% - 100% and sometimes exceeds 100% because AAF receives more articles than required. To calculate this number use cell number 33 "REQTY", which records the initial required amount of items, cell number 34 "CREQTY", the current amount required which may vary from the original quantity required, and cell number 36 "SQTY", the quantity finally shipped. Therefore, both percentages are obtained for each document: one from the shipped quantity and the initial required quantity ( $SQTY / REQTY$ ) and the other between the shipment quantity and the current required quantity ( $SQTY / CREQTY$ ).

Then, we proceed to make an average of all percentages across the master file for both options. This index is an aggregate indicator that returns a percentage to the manager to help visualize the extent in which orders filled are. We can also remove the orders that were fully cancelled by the customer, so the result is a rate closer to reality. In this case use the difference between "CREQTY", and the cell number 35 "CQTY", remove the orders with no zero value, and proceed to do the average percentage of the ratio  $SQTY / CREQTY$ .

- d) Number of procedures considered Standard and Non Standard: One of the features to consider about the requirements is whether procurement is Standard or Non Standard type. In cell number 13 "ESTDOCID", record the code corresponding to the status of the request. In general, requisitions bearing document identifier A01 (Standard) are clearly defined by a NSN,



and requisitions bearing document identifier A05 (Non Standard) are used when the requisition contains a part number and data in the remarks fields. Examples of exception data include further identification data, exceptions to normal mode of delivery, and exception to levels of protection. There are other codes like A02 for overseas requisitions with a part number, A04 which is used for requisitions that contain other than a NSN or part number, and BMB requisitions for ARMY publications. The codes A01, A02, A04, A05, and BMB are requisitions codes and were used to determine which percentage of requirements were processed as Standard and those as Non Standard. Particularly codes A01, A02, A04, and BMB are Standard processes, and A05 is a Non Standard process. We created another category "other" to concentrate the rest of the codes not considered previously.

- e) Number of successful and canceled or rejected acquisitions by type Standard or Non Standard: In this case and using the type of acquisition we differentiate the procedures which have successfully completed and which have been canceled or rejected in magnitude and percentage. The result is achieved via sorting and counting the procedures using cell number 13 "ESTDOCID" and the different Document Identifier Codes in cell number 29 and the different Transaction Status Codes recorded in cell numbers 24 and 30. So, according to this analysis it is possible to

distinguish three categories: successes, cancellations/reject, and back orders/delays.

- f) Comparison Standard and Non Standard procurement across the years:

Taking only the successful procedures, codes “XDF”, “XDI” or “XDS” in the LSTAUTODOC column and sorting and counting by year, it is possible to view the progression of the procurement through the years by the type of the contract.

- g) Cancellations and Rejections Reasons: Taking only the cancellations or rejections codes from the previous success or failure analysis we can isolate the reasons and make a count of the different causes and identify what are the main causes of this situation. After that, it is possible to distinguish which causes originated from the customer and which ones come from the supplier. By identifying these reasons, a manager may set a desirable level of rejection and take the necessary actions to achieve the accepted level.

- h) Cancellations or rejections across the years: A further analysis is to look at the total number of cancellation/rejection procedures in a corresponding year. Hence it is possible to check if throughout the years the level of cancellations/rejections increase or decrease. This might reveal a learning curve with the system. Also it is possible to check a relative cancellation/rejection magnitude regarding the volume of procurements

processed in each year and verify if the cancellations/rejections relative to volume increase or decrease.

## Time in the System

One derived indicator to learn is how much time passes from the moment the operator places an order in the system until the material is shipped to the warehouse in Washington, DC. This metric represents the system's lead average time and knowing this value improves planning capability. The master file has inside several dates and is possible to distinguish the starting and ending point for the process.

The starting point date is part of the Document Number and is located from the seventh position to the tenth position in a julian format. A julian date format usually is a codification that contains five positions. The first two represent the year and the last three represent the number of the consecutive days in the year from January 1 (001) to December 31 (365). Table 3.2 shows the Document Number format and the location of the starting date in a julian format.

**Table 3.2 Document Number Format and date location in julian format**

D	A	R	B	5	V	4	1	2	8	3	0	3	4
US Service	Country	Code	Mark for	Delivery terms	Type Assistance	Julian date				Document serial number			
						Year		Date					
						Last 8							

In this case it has only four positions, one for the year and the last three for the consecutive days. Therefore, it is necessary to complete the missing number from another data date that appears in each line. For instance, cell number 31 “ESTRQDT”, which is

the date that the system recognizes the order, is fairly similar to the previous starting date. After extracting these characters, we transform to a Gregorian format in order to obtain the ending date and get a delta date value. The ending date is in cell number 44 “TRANSDTE”, which is the date that the system registered the shipment to the Argentina warehouse and it is in a Gregorian format. With these two values available it is possible to sort in different ways the data and observe which statistic characteristics have each option. The data analyzed are the successful procurements indicated with XDF, XDS, and XDI codes in the “LSTAUTODOC” column and possesses complete date values. This calculation results in 14,172 records.

With delta date calculated, the metrics in time delays can be broken down as:

- a) Time in the system by type of acquisition: Having the delta date between the finish and starting date and sorting the available data (13,841 records) regarding the cell number 13 “ESTDOCID” it is possible to separate the standard and non standard procurements and determine if their delta dates are similar.
- b) Time in the system by US Services and type of acquisition: Using the same methodology, but now also taking in consideration cell number 2 “USSERV”, it is possible to sort the data by US Service and type of acquisition and get its delta date for each acquisition. So, two distributions, standard and non standard are obtained for each US Service.

While investigating time delay in the system, we learned of an interesting fact. The FLO has limited decision authority. When a question is received from the system that the FLO must address before procurement proceeds, the FLO cannot answer it directly even though the FLO has the professional knowledge to do that. Instead the FLO must ask the AAF headquarters in Argentina. This situation extends the time in the system, is time consuming, contributes to a lack of visibility, and could increase unnecessary error.

### **Regressions**

This part of the study addresses possible correlations between predictor variables and time in the system represented by delta date values, a difference between cell number 44 “TRANSDTE” and the Document Number ID date. Hence it is possible to evaluate the influence of some particular variables existing in the data base over time and detect whether any variable has more impact in the acquisition time than others. Also it is possible to construct a regression model with those variables to predict what will be the length of time in the system for a future acquisition and may give the manager an opportunity to improve planning and procedures. In order to perform this analysis the study uses pairwise correlation methods and multivariate linear regression. In both cases we observe how strong the relation is between variables; meaning that a change in one variable represents some change in the other, where a  $R^2$  (coefficient of determination) close to 1 means a strong correlation between them. We also have to check for each variable's significance. For each hypothesis test, we set the level of significance at 0.05.

The subset of the data base for this analysis is taken from the acquisitions with a code XDF, XDS, and XDI in cell number 29 “LSTAUTODOC”. The database consists of procurements that have a correct Federal Supply Classification according to the H2 Handbook Manual of the Defense Logistic Agency 2003 Edition, must possess a correct country priority and finally a code indicating standard and non standard acquisition type. So, after selecting the data we have available a subset with 12,258 records along with four possible variables.

- a) Country Priority: A priority designator is used in the acquisition system which is based on two factors. The first is the Force Activity Designator (FAD) that the Joint Chiefs of Staff assigned in their directive CJCSI 4110.01 to each foreign country, the second is the Urgency of need (UND) category (A: Extremely urgent requirement, B: Less urgent requirement, C: Routine requirement) which is set by the customer. The cell number 8 “PRTY” records the country priority. This code in conjunction with the delta date associated with each acquisition allows us to test the correlation in order to determine whether the country priority has any impact in the time in the system. Table 3.3 shows the different country priorities according to the FAD and the UND.

**Table 3.3 Country priorities. Table 10-2 Page 10-13 “MSA 29<sup>th</sup> Edition”**

FAD	Urgency of Need		
	A	B	C
I	1	4	11
II	2	5	12
III	3	6	13
IV	7	9	14
V	8	10	15

- b) Federal Supply Classification (FSC): The National Stock Number is a 13-digit numeric code, identifying all the standardized material items of supply as they have been recognized by all NATO countries including the United States Department of Defense (DOD). The four first digits mean the Federal Supply Classification and is a way to classify the different type of elements that AAF purchases. Therefore, and in conjunction with the delta date, we can observe whether there is any correlation between the class of the element purchased and the time. Moreover, making a histogram of the FSC we determine which items are more requested for the AAF.
- c) Standard and Non Standard acquisition: Assigning a particular code for the type of acquisition, for example standard purchases  $A01 = 1$  and for non standard purchase  $A05 = 2$ , and in conjunction with the associated delta date we can verify if there is any correlation between the type of the procurement and the time in the system.

- d) U.S. Service: In the same manner assigning a particular code to each U.S. Service like Army Code B = 1, and Navy Code D = 2, and USAF Code P = 3 and in conjunction with the delta date it is possible to detect any correlation between the U.S. Service and the time in the system.

The prior explanations and paragraphs in this chapter explain the methodology the study uses in order to arrive at our conclusions and answer the research questions. Those results are presented in the next chapter. In Chapter V, we discuss these conclusions and findings.



## IV. Results

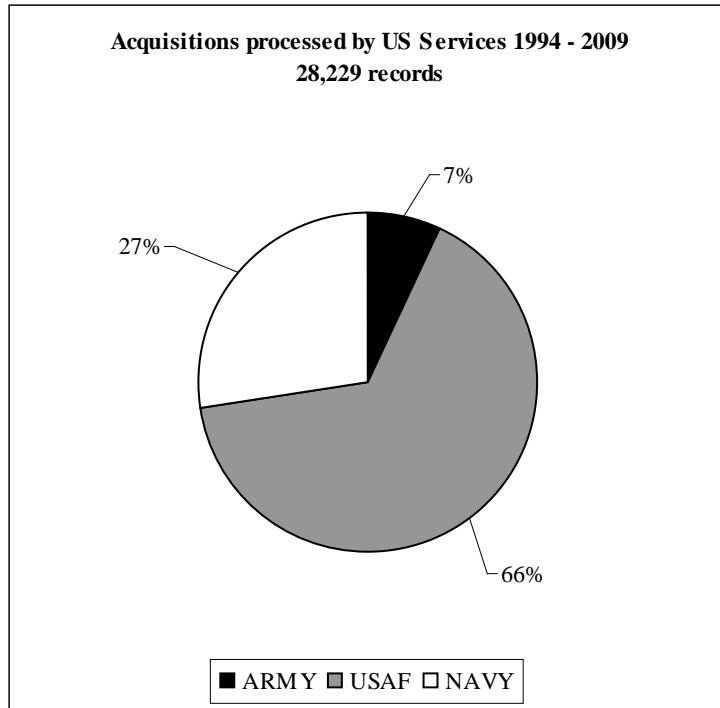
The previous chapter explained how the research is conducted and now this chapter shows the results from this analysis. The results are presented according to the different aspects considered in Chapter III: Process Characteristics, Time in the System and Regressions. All numerical analysis, calculations and regressions used the JMP<sup>®</sup> V9.0 statistical software.

### Process Characteristics Analysis.

- a) Percentage of processes initiated by U.S. Service: The processes initiated by AAF through the different U.S Services totaled 28,229 records. The breakdown of this number with their respective percentages is shown in Table 4.1 and Figure 4.1

**Table 4.1 Quantity of acquisition initiated process by US Services**

US Services	Qty	%
ARMY	1984	7.03%
USAF	18505	65.55%
NAVY	7740	27.42%
TOTAL	28229	100.00%

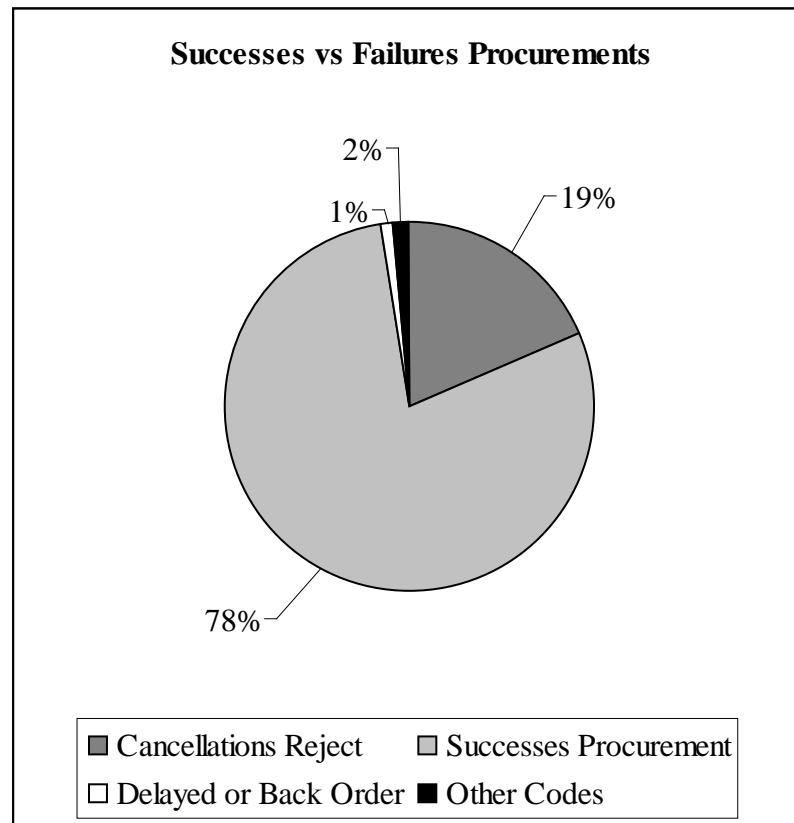


**Figure 4.1 Percentages of acquisition initiated by AAF through U.S. Services**

- b) Percentage of successful processes versus cancellations or rejections: Table 4.2 along with Figure 4.2 shows the breakdown of 28,229 orders with respect to success, delays, or cancellations.

**Table 4.2 Successes, Cancellations and Back Orders purchases**

Action	Qty
Cancellations Reject	5302
Successes Procurement	22208
Delayed or Back Order	303
Other Codes	416
Total	28229



**Figure 4.2 Successes, Cancellations and Back Orders purchases**

- c) Percentage of Fill Rate (FR): Taking all the available data, 28,229 records, the study arrived at the following percentages showed in Table 4.3. and Table 4.4.

**Table 4.3 Percentages of the orders fill rate**

Cell name	Cell number	Ratio	Average of ratio % Fill Rate
Initial Requirement Quantity	33	$SQTY / REQTY$	84.80
Current Requirement Quantity	34	$SQTY / CREQTY$	76.59

Removing the fully cancelled orders by customer. $CREQTY - CQTY = 0$ and performing an average of percentages	92.71
--	-------

**Table 4.4 Quantity of order corresponding to different FR percentages**

	Requirement Quantity Cell	Current Requirement Quantity Cell	Removing the full cancelled orders
Percentage	Quantity	Quantity	Quantity
FR = 0%	6326	6224	124
FR <= 50%	662	526	20
50% < FR < 100%	434	384	14
100%	20492	20910	22834
FR >= 100%	223	8	0
Orders with: * Req. Qty or Current Req Qty = 0 * Full cancelled	92	177	5237
Total	28229	28229	28229

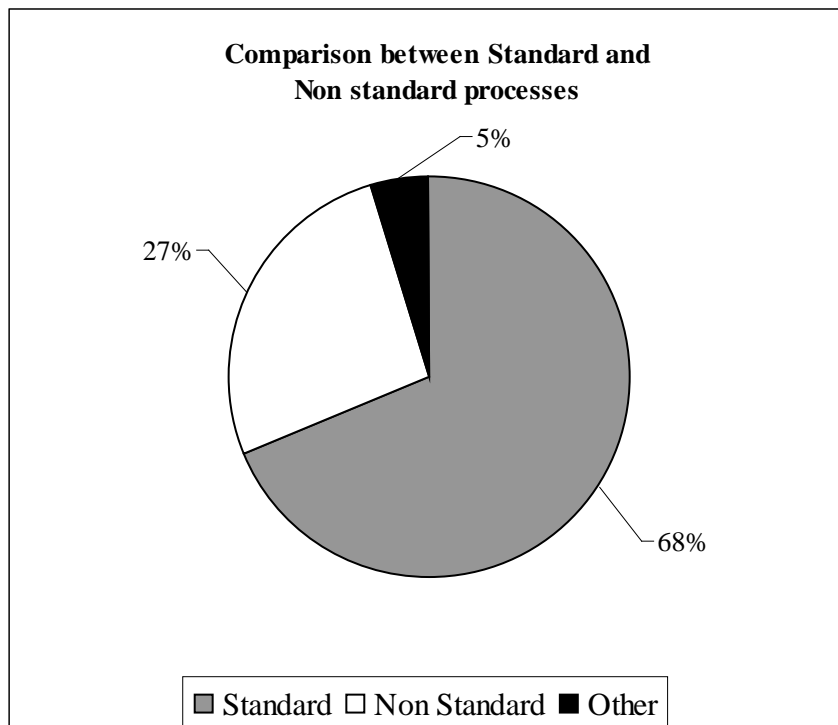
- d) Number of procedures considered Standard and Non Standard: 28,229
- processes initiated Standard or Non Standard. Of these, only 24,909 are denominated as a requisition action. Table 4.5 shows the different quantities assigned to the corresponding code, for all 28,229 processes. Table 4.6 shows a summary of the quantity orders. Meanwhile, Figure 4.3 shows a graph representing those percentages.

**Table 4.5 Orders quantities assigned to each code in the ESTDOCID cell**

Cell name	Orders Quantity	Observations	
ESTDOCID All codes			
No Code	2027	Any kind of cancellations	Code N8: Processing criteria preclude supply action after BW code
		1877	150
A01	17517	Requisition Overseas NSN	
A02	8	Requisition Overseas Part Number	
A04	373	Requisition Overseas with other	
A05	6993	Requisition Overseas with exception	
A0X	15	N/A information	
AT1	39	Follow-up Overseas NSN	
BMB	18	Requisition Army Publication	
C0N	381	USAF CASES SAMIS	C0: Customer Order
C0P	9	USAF CASES SAMIS	
C0R	41	USAF CASES SAMIS	
MG1	43	N/A Information	
X01	88	NAVICP MISIL	
X04	146	NAVICP MISIL	
X05	83	NAVICP MISIL	
X0A	9	NAVICP MISIL	
X0F	3	NAVICP MISIL	
X0J	7	NAVICP MISIL	
XDC	13	Materiel Return	
XG3	69	Rejected Customer Requisition	
XKJ	1	NAVICP MISIL	
XL1	305	NAVICP MISIL	
XL4	1	NAVICP MISIL	
XL5	38	N/A Information	
XPI	1	NAVICP MISIL	
XZQ	1	N/A Information	
	28229		

**Table 4.6 Data code summary**

Type of procurement	Qty	Total	Percent
A01	17517	17916	63.5%
A02	8		
A04	373		
BMB	18		
A05	6993	6993	24.8%
Other (Including some cancellations, Follow-up)	3320	3320	11.7%
	Total	28229	100.00%

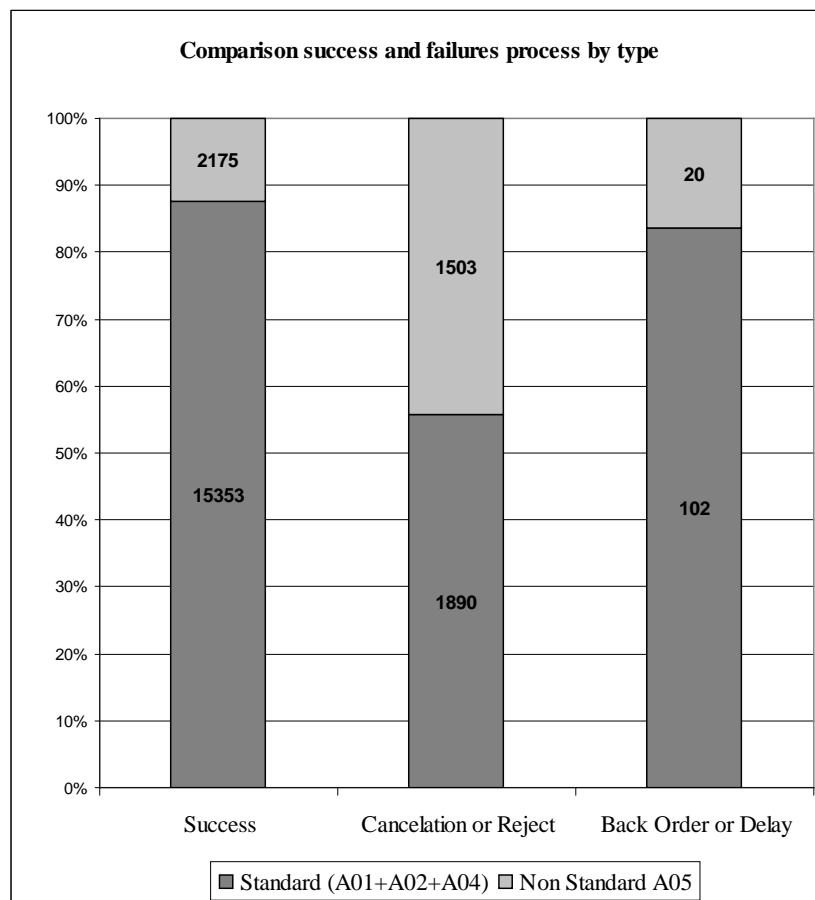


**Figure 4.3 Percentages of Standard and Non Standard acquisitions**

- e) Number of successful, canceled or rejected acquisitions by type Standard or Non Standard: Table 4.7 shows the different amount of orders corresponding to each category, Standard and Non Standard, and distinguishing among Successes, Cancellations or Back Orders (BB) and Delays. Meanwhile Figure 4.4 shows a graph of these values.

**Table 4.7 Quantity of orders categorized by type and Successes, Failures or BB**

	Standard (A01+ A02 + A04)	Non Standard A05	Other Codes
Successes	15353	2175	
Cancellations or Rejects	1890	1503	
Back Orders or Delays	102	20	
Other Codes	552	3296	3338
Subtotal	17897	6994	3338
Total	28229		

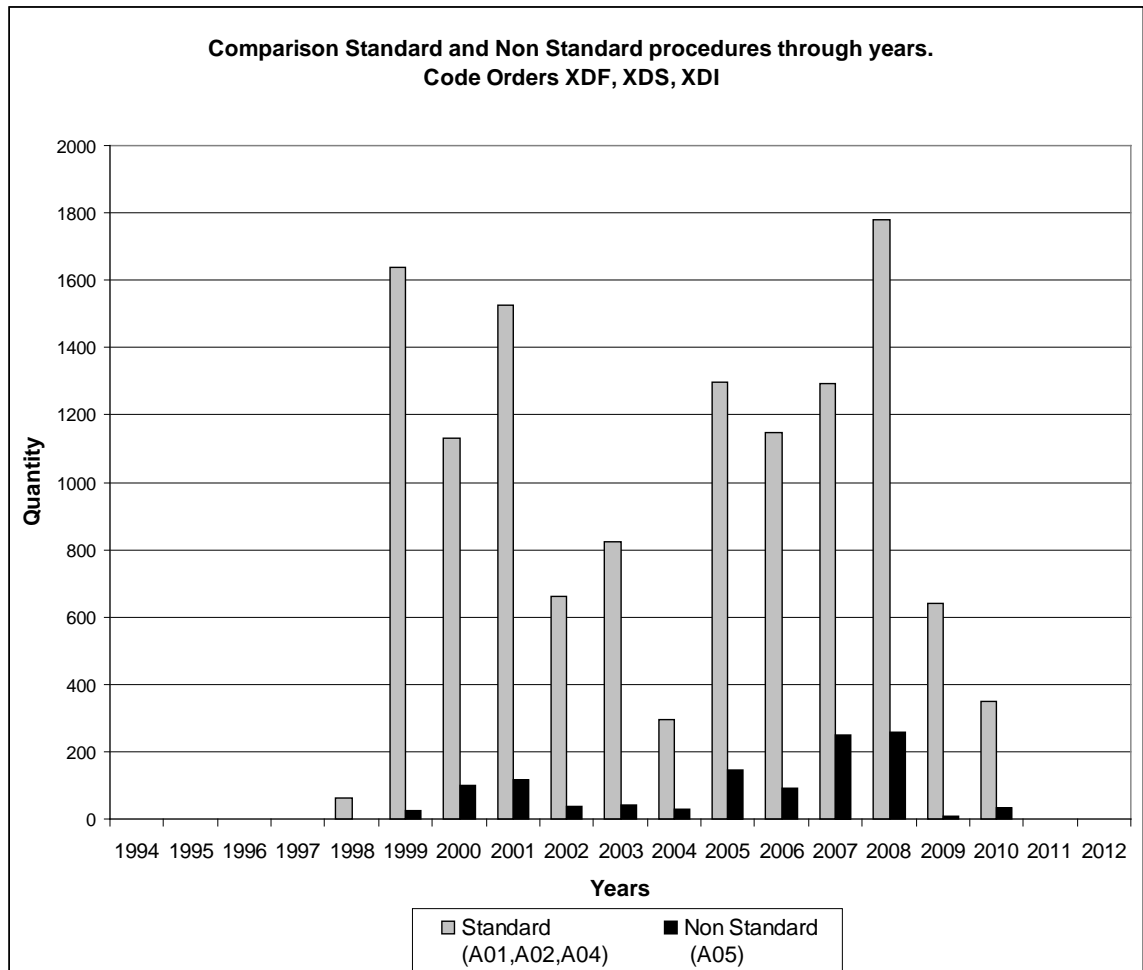


**Figure 4.4 Comparison of the Successes, Cancellations or Rejects and BB by type of acquisition**

f) Comparison of Standard and Non Standard procurement across the years:

Figure 4.5 shows a comparison of the procurements categorized by type

through the years, taking the beginning date from the Document Number date when the order is placed. 13787 records were considered (XDF,XDS,XDI).



**Figure 4.5 Comparison of the procedures by type through the years**

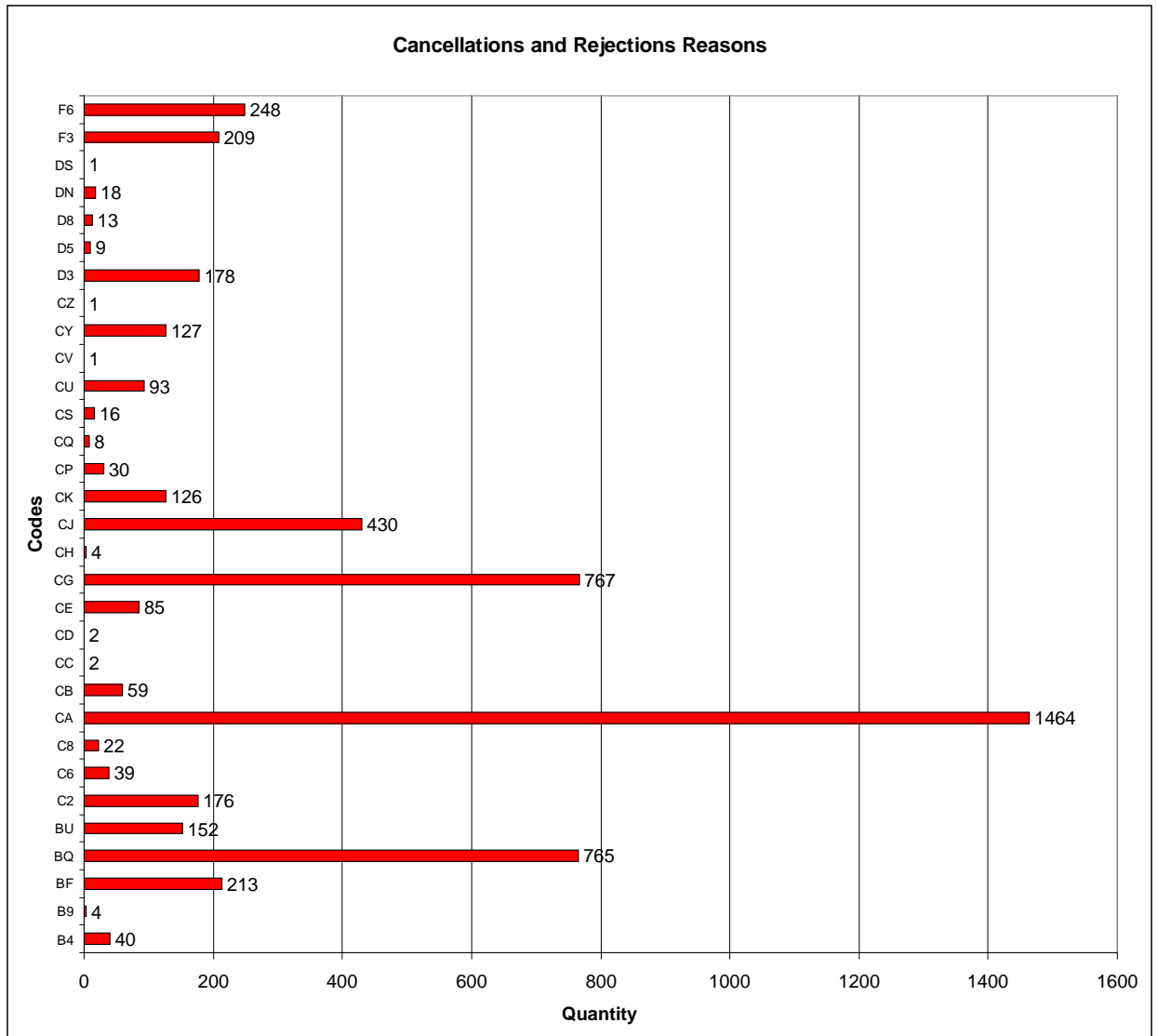
- g) Cancellations and Rejections Reasons: Table 4.8 shows the orders assigned to the cancellation codes and who is considered responsible. Table 4.9 shows a summary of these percentages and the Figure 4.6 graphs these values.



**Table 4.8 Orders with Cancellations Rejections Codes and responsibility. "C" represents customer, AAF, while "S" represents supplier.**

Cancellations Rejections	Short Explanation	Who	Qty	%
B4	Cancellation from requisitioner. Contract termination charges will be made.	C	40	0.75
B9	Cancellation request.	C	4	0.075
BF	No document record or cancellation request.	C	213	4.01
BQ	Cancellation from requisitioner.	C	765	14.4
BU	Duplicate requisition.	C	152	2.8
C2	Reject. International Logistic Program funds are not available to process this requisition.	C	176	3.3
C6	Rejected. Requisition is for commercial type, non authorized under FMS.	S	39	0.73
C8	Rejected. Vendor no accepts order for quantity less than the quantity indicated.	S	22	0.41
CA	Rejected. Explanation in the narratives.	-	1464	27.6
CB	Rejected. Quantity not available for immediate release or not available.	S	59	1.1
CC	Non consumable item. Your service is not a registered service.	C	2	0.03
CD	Reject. Errors in quantity, date, and/or serial number.	C	2	0.03
CE	Reject. Unit of issue does not agree with the Inventory Control Point and cannot be converted.	C	85	1.6
CG	Reject. Unable to identify requested items.	C	767	14.4
CH	Reject. The source for the requisition cannot be determined.	C	4	0.075
CJ	Rejected. Obsolete, inactive item.	S	430	8.1
CK	Rejected. Unable to procure.	S	126	2.3
CP	Rejected. If the item can be fabricated locally submit a new requisition.	S	30	0.56
CQ	Rejected. Item is controlled or regulated.	C	8	0.15
CS	Reject. Quantity requisitioned is suspect of error or indicates excessive quantity.	C	16	0.3
CU	Rejected. Unable to procure. Item no longer produced by any known source. Item can be furnished as substitute.	S	93	1.7
CV	Rejected. Item prematurely requisitioned.	C	1	0.018
CY	Rejected. Unable to procure. Item no longer produced by any known source.	S	127	2.39
CZ	Rejected. Item reserved for troop issue only.	S	1	0.018
D3	Rejected. Activity did not respond to supply source request for additional information.	C	178	3.35
D5	Rejected. Item requisitioned is a Nuclear Reactor Plant materiel.	C	9	0.17
D8	Rejected. Requisition is for controlled substance and ship to address is not an authorized recipient.	S	13	0.24
DN	Rejected. The item, the requisitioner or the DOD Activity Address Code is not authorized Government Furnished Materiel under the contract.	S	18	0.34
DS	Requisition received for an item for which your service is not a registered user.	S	1	0.018
F3	Rejected. SA program line in cut off or suspended status.	C	209	3.94
F6	Rejected. Item not authorized for requisitioning under FMS Cooperative Logistics Supply Support Arrangement (CLSSA)	S	248	4.67
Total			5302	

**Figure 4.6 Quantity orders with cancellations or rejected codes**



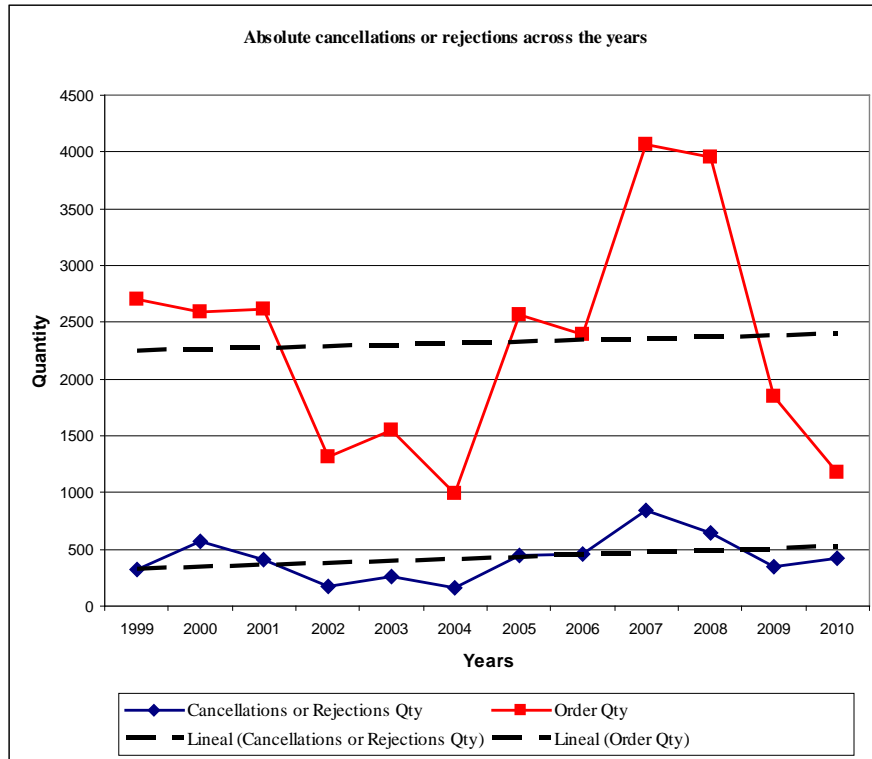
**Table 4.9 Summary of the percentage responsible for cancellations**

	Qty	%
Customer	2546	48.00%
Supplier	1292	24.4%
CA code	1464	27.6%
Total	5302	100%

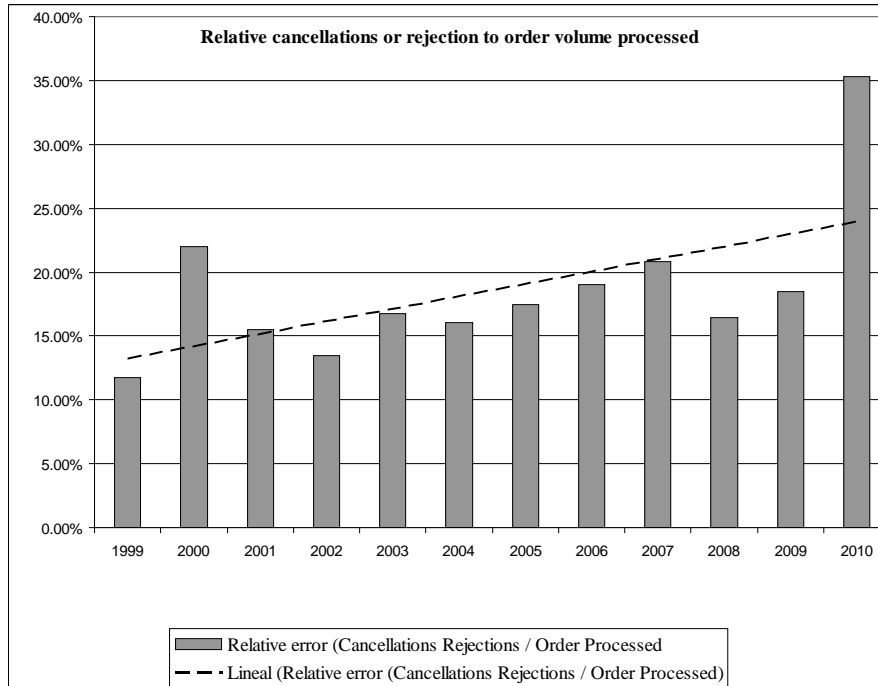
- h) Cancellations or rejections across the years: Table 4.10 lists the cancellation codes through the years. We lost one record since it listed a starting year of 1991, but STARR/PC started effectively in 1994. Figure 4.7 shows the evolution of cancellation orders through the years in comparison with the total procurement orders including a trend line. Meanwhile, Figure 4.8 shows a relative evolution of cancellation through the years to the total procurement orders including a trend line. In both cases we select data from 1999 to 2010 because the purchase order amount is relatively consistent.

**Table 4.10 Orders by cancellation codes through the years**

Cancellations Rejections	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
B4				1		15	9		1					1	10	2	1			40
B9							1								1		2			4
BF				1		1	12	1		87	4	26	14	55	5	1	6			213
BQ			1	12	4	38	73	35	13	39	28	87	98	98	111	22	52	54		765
BU						7	2	4	5	10	14	16			20	41	27	1	5	152
C2							4		1		8	3	4	104	49	3				176
C6							7	2	8	2	1	1	7	3	6	1	1			39
C8					2		2	3				3	4	1	1		6			22
CA	1		1	11	17	50	176	239	46	17	30	131	107	238	128	104	154	13	1	1464
CB			1		1	1	4	8		12	4	17	4	2	2	1	1			59
CC												1			1					2
CD											1	1								2
CE						6	21	10	3	1		6	4	13	10	6	2	3		85
CG					1	132	112	21	37	19	10	21	79	121	102	30	62	20		767
CH									2					1			1			4
CJ				1		7	83	32	40	43	11	32	36	65	39	16	21	4		430
CK				1	1	4	13	4	1	1		9	9	19	23	12	14	15		126
CP						3	5	1	2		1	4	1	6	5	1	1			30
CQ							2	2	1					2			1			8
CS							1				3	2	2	1	1	1	4	1		16
CU					1			2	2	2		1	8	15	48	5	6	3		93
CV											1									1
CY					3	48	31	14	5	7		6	1	2	7		3			127
CZ													1							1
D3							1	7	2	10	6	64	40	11	31	5	1			178
D5							4	1	3						1					9
D8						5	4	2	1		1									13
DN										6		8			4					18
DS															1					1
F3								12			11	1	36	53	6	12	3	75		209
F6							3	6	4	3	26	7	1	35	37	78	48			248
Total	1	0	3	27	30	317	570	406	177	259	160	447	456	846	649	341	417	190	6	5302
Orders	2	2	9	53	164	2703	2591	2616	1313	1547	996	2564	2396	4067	3952	1847	1182	209	15	28228
%	50.00%	0.00%	33.33%	50.94%	18.29%	11.73%	22.00%	15.52%	13.48%	16.74%	16.06%	17.43%	19.03%	20.80%	16.42%	18.46%	35.28%	90.91%	40.00%	



**Figure 4.7 Absolute evolution of the cancellation orders through the years**



**Figure 4.8 Relative cancellation orders through the years to the total orders**

## Time in the system

- a) Time in the system by type of acquisition: Figure 4.9 shows the histograms of the delta dates in the system by type, Standard and Non Standard acquisition process. Table 4.11 is a tabular summary of the delta dates.

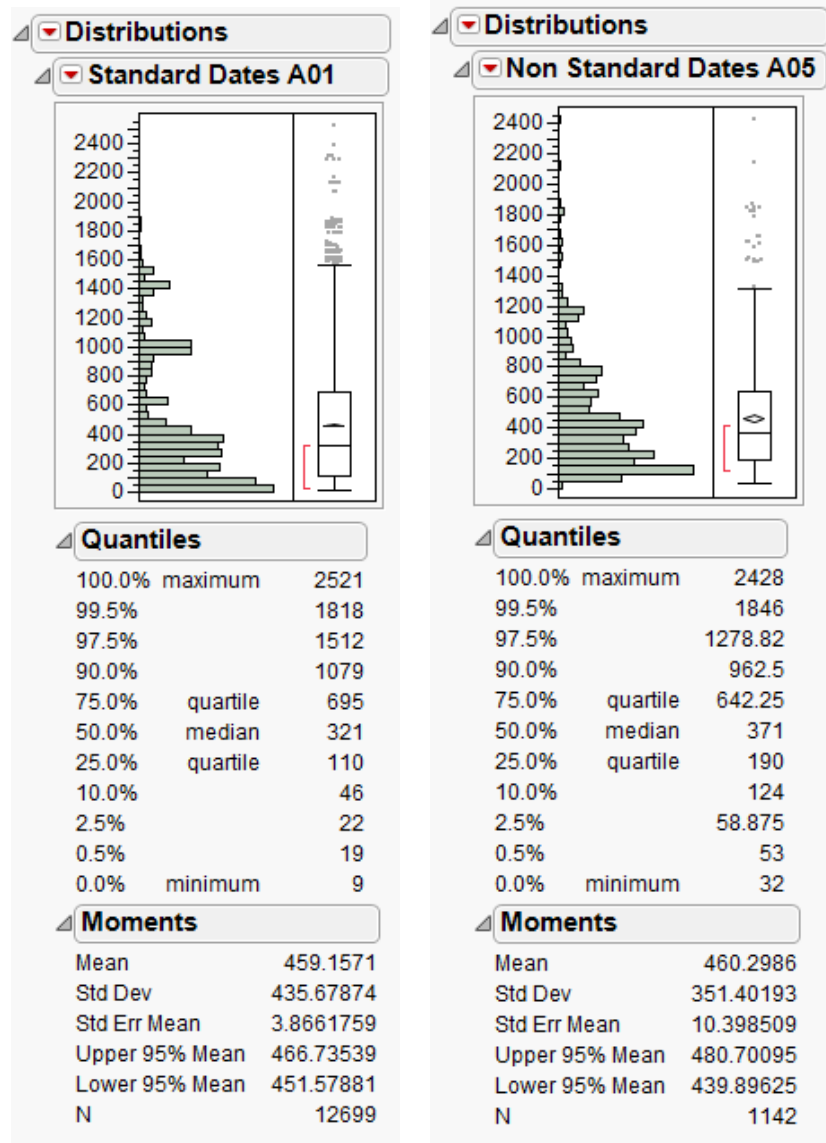
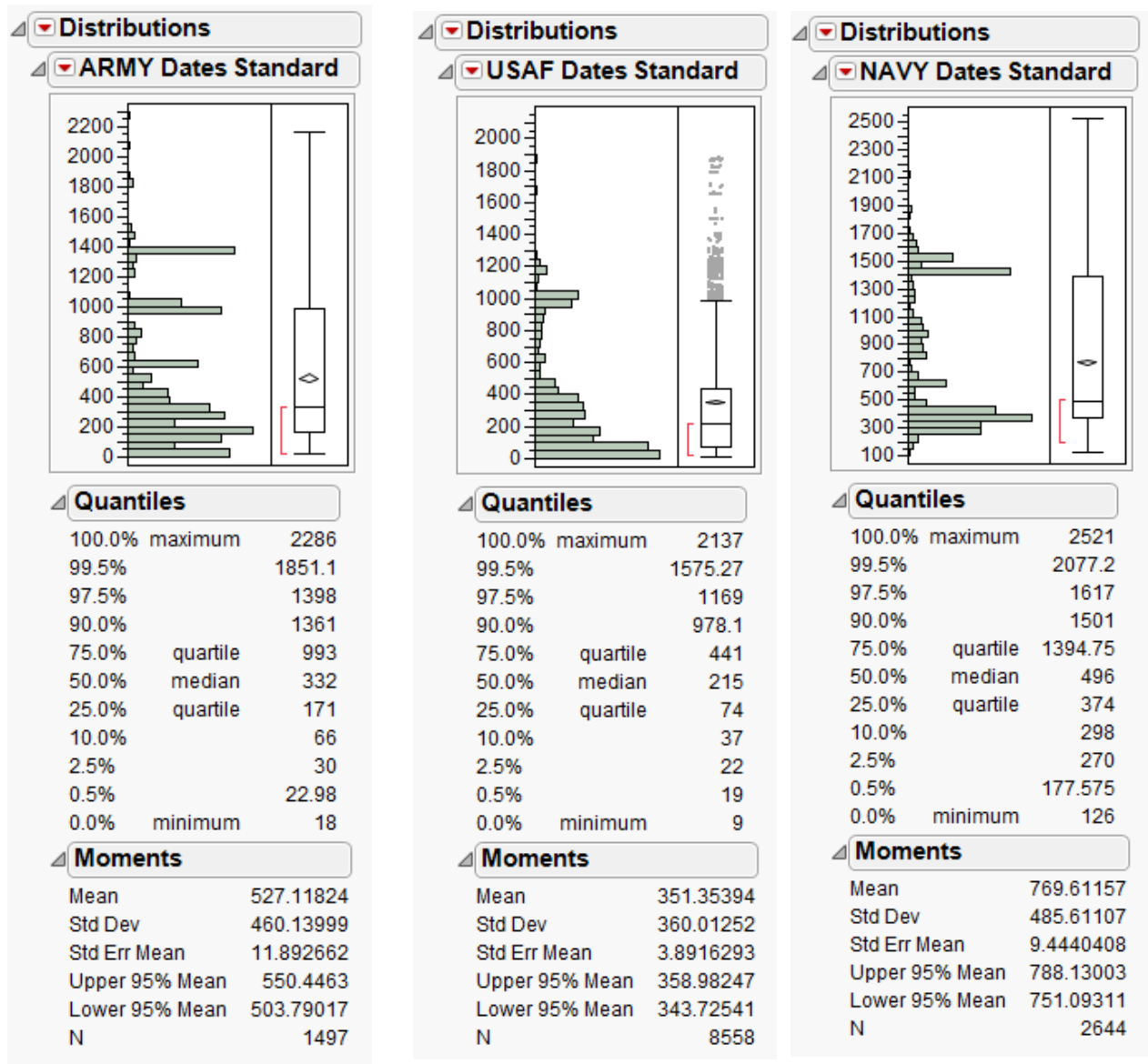


Figure 4.9 Distribution of the Delta dates by type of acquisition procurement

**Table 4.11 Summary of the delta dates distribution statistics values**

	Standard	Non Standard
MEAN	459	460
MEDIAN	321	371
St Dev	435	351
N	12699	1142

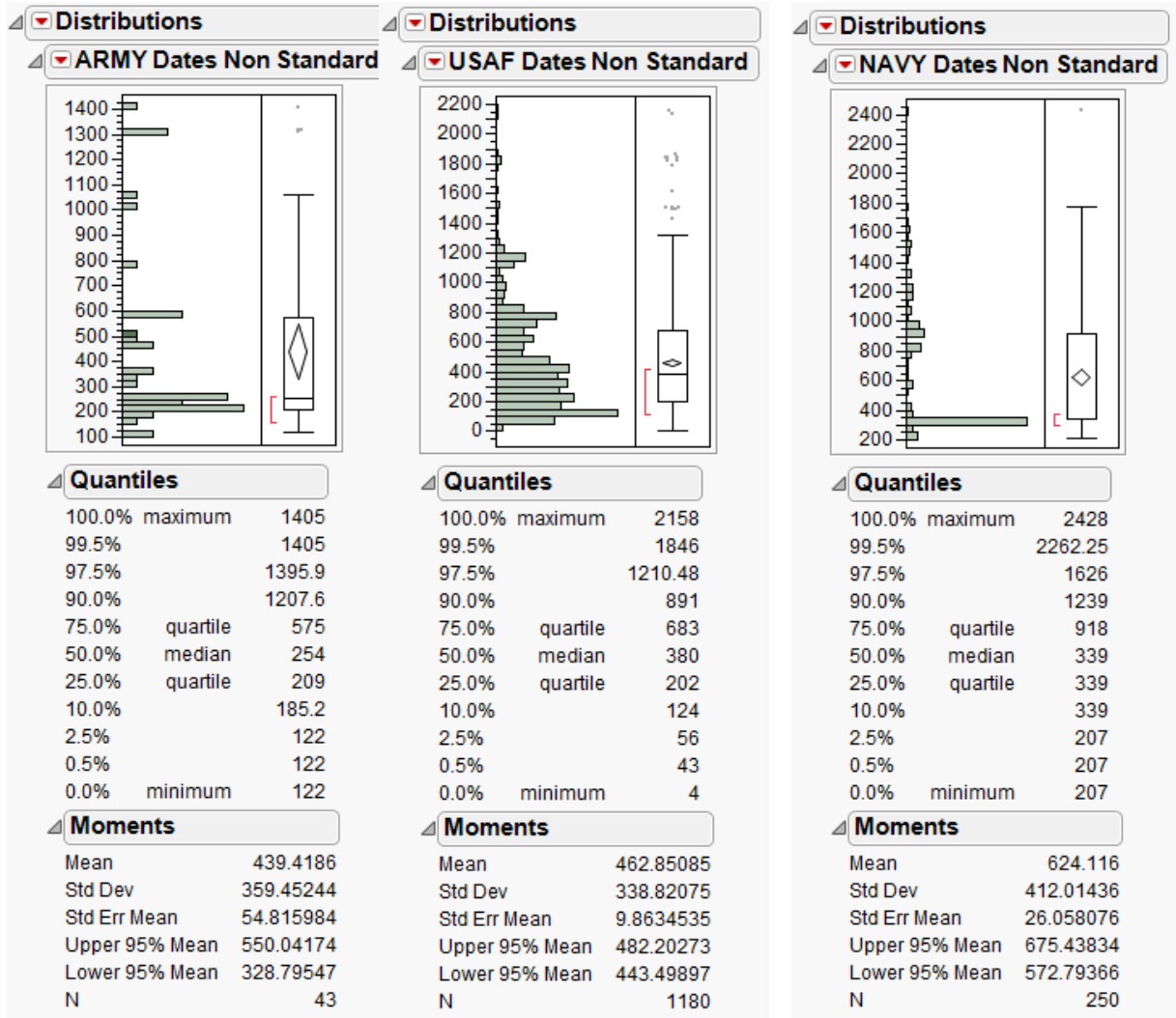
- b) Time in the system by US Services and type of acquisition: Figure 4.10 shows the histograms of the delta dates in the system by U.S Services Standard procurements and Figure 4.11 shows the histograms of the delta dates in the system by U.S Services Non Standard procurements. Table 4.12 is a tabular summary of the delta dates for Standard procurements, while Table 4.13 represents the data for Non Standard procurements.



**Figure 4.10 Distribution of the Delta dates by U.S. Services Standard process**

**Table 4.12 Summary of the delta dates distribution statistics values for Standard processes**

Standard	ARMY	USAF	NAVY
MEAN	527	351	770
MEDIAN	332	215	496
Std Dev	460	360	486
N	1497	8558	2644



**Figure 4.11 Distribution of the Delta dates by U.S. Services Non Standard process**

**Table 4.13 Summary of the delta dates distribution statistics values for Non Standard processes**

Non Standard	ARMY	USAF	NAVY
MEAN	439	463	624
MEDIAN	254	380	339
Std Dev	359	339	412
N	43	1180	250



## Regressions

The four independent variables considered from the subset database codes XDS, XDF, and XDI include:

- a) Country Priority.
- b) Federal Supply Classification (FSC).
- c) Standard and Non Standard acquisition.
- d) U.S. Service.

Figure 4.12 shows the multivariate pairwise correlations for all four variables considered and the Delta Dates. Also a histogram for each independent variable is included.

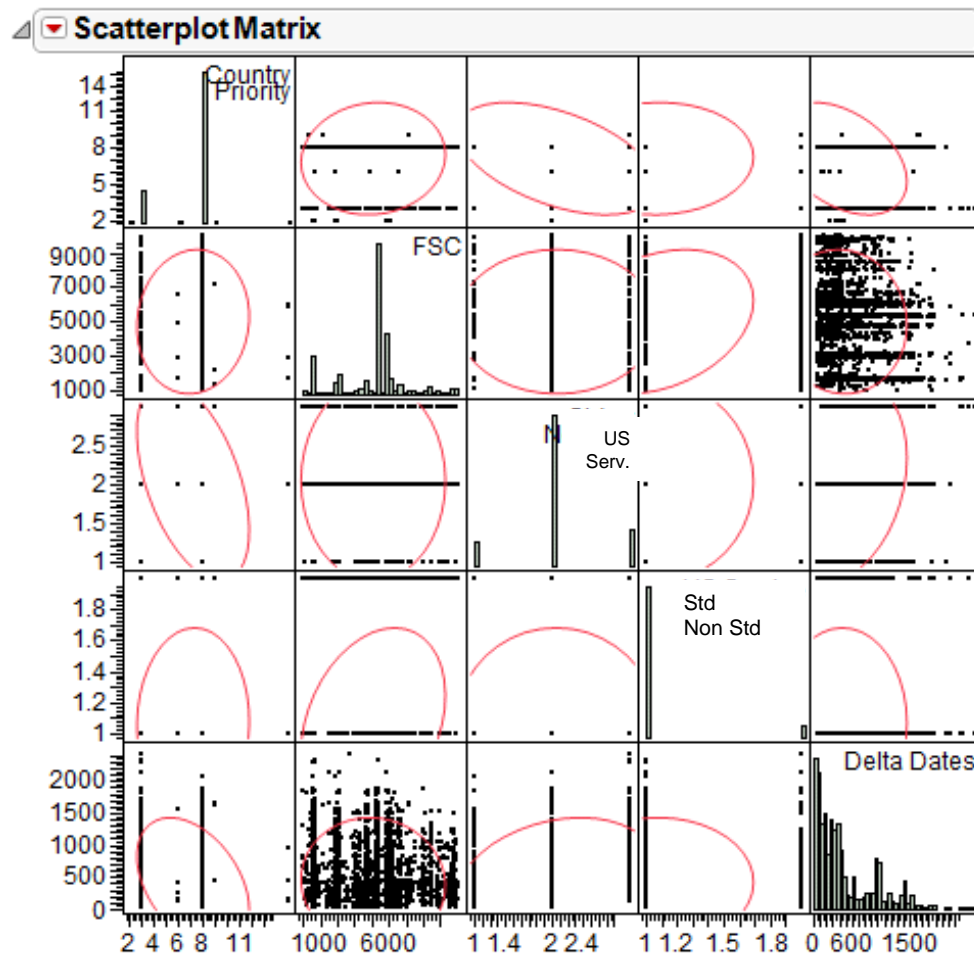


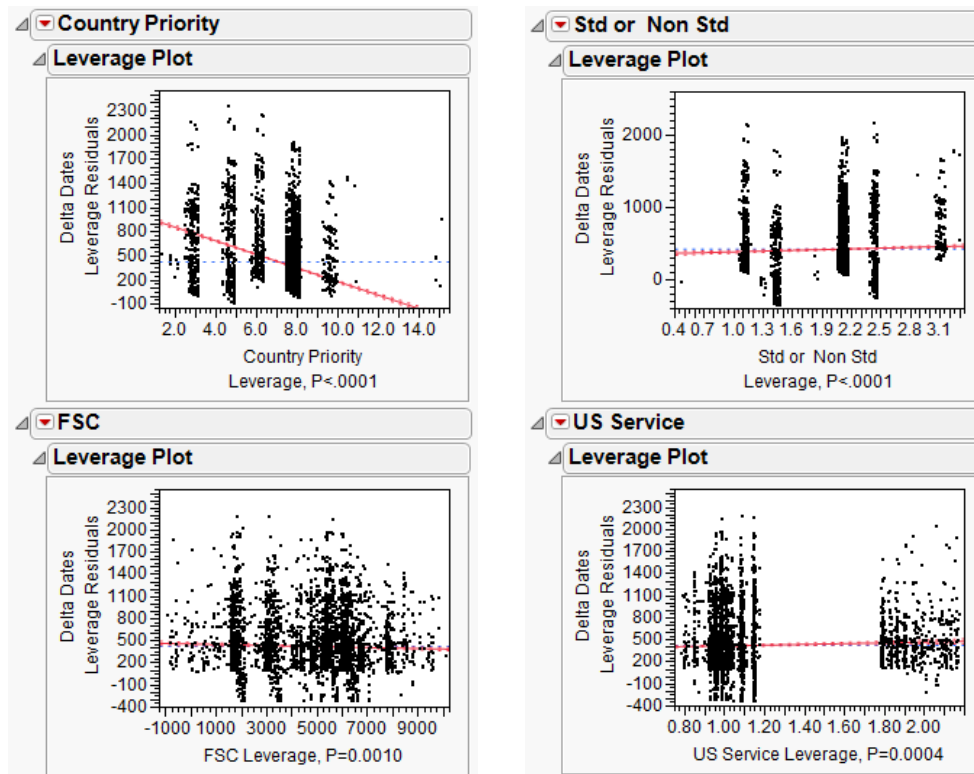
Figure 4.12 Multivariate pairwise estimation JMP® V9

Figure 4.13 shows all the correlations values for the multivariate pairwise comparison. The relevant values with respect to delta dates are highlighted. Three of them present p-values less than 0.05 level of significance, which we discuss in the next chapter.

Pairwise Correlations						
Variable	by Variable	Correlation	Count	Lower 95%	Upper 95%	Signif Prob
FSC	Country Priority	0.0713	12258	0.0536	0.0889	<.0001*
Std or Non Std	Country Priority	-0.4919	12258	-0.5052	-0.4783	<.0001*
Std or Non Std	FSC	-0.0000	12258	-0.0177	0.0177	0.9977
US Service	Country Priority	0.0272	12258	0.0095	0.0449	0.0026*
US Service	FSC	0.2967	12258	0.2805	0.3128	<.0001*
US Service	Std or Non Std	-0.0089	12258	-0.0266	0.0088	0.3230
Delta Dates	Country Priority	-0.4080	12258	-0.4226	-0.3931	<.0001*
Delta Dates	FSC	-0.0468	12258	-0.0644	-0.0291	<.0001*
Delta Dates	Std or Non Std	0.2326	12258	0.2158	0.2493	<.0001*
Delta Dates	US Service	0.0114	12258	-0.0063	0.0291	0.2057

**Figure 4.13 Correlations values and the statistical significant level**

Figure 4.14 shows the leverage plots for each variable as a regressor of the delta date.



**Figure 4.14 Leverage plots for each variable as a regressor of the delta date**

Figure 4.15 shows the multivariate regression model using the four considered independent variables. All the coefficients are statistically significant  $< 0.0001$  which is much lower than 0.05, the customary level of significance. Despite this, the  $R^2$  is low with a value of 0.169.

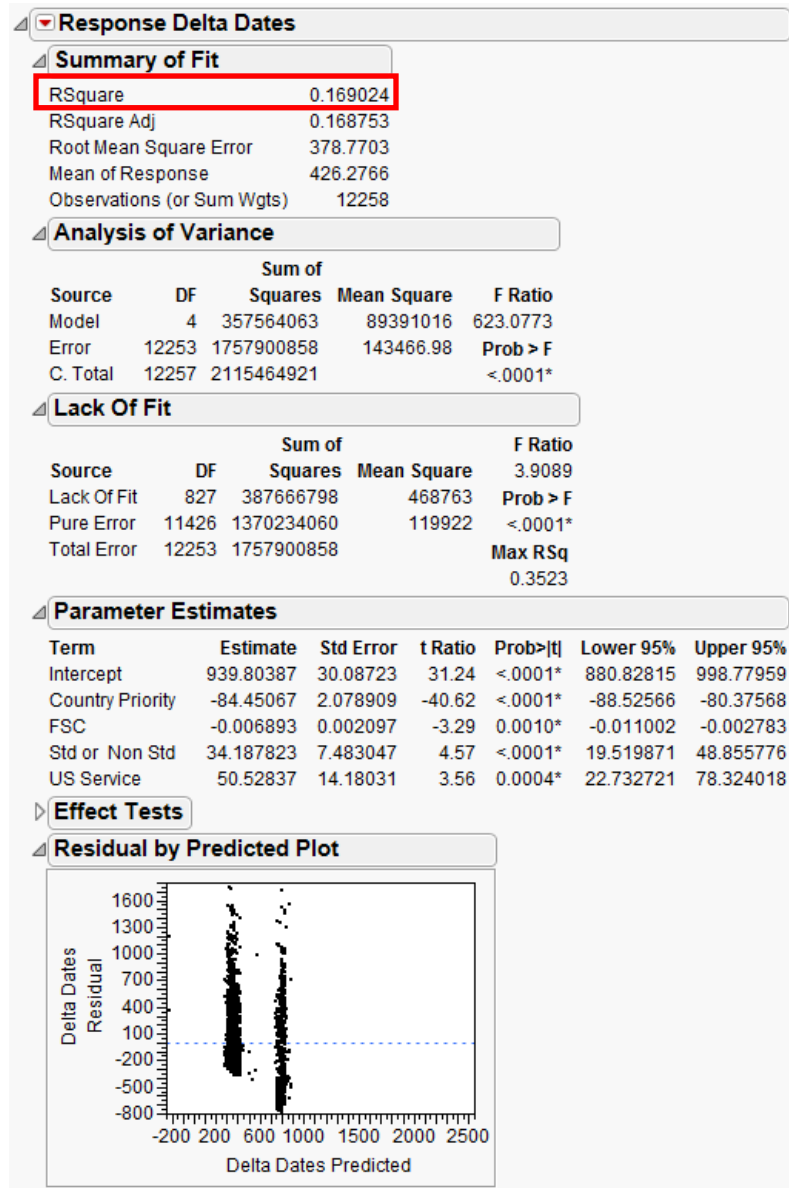
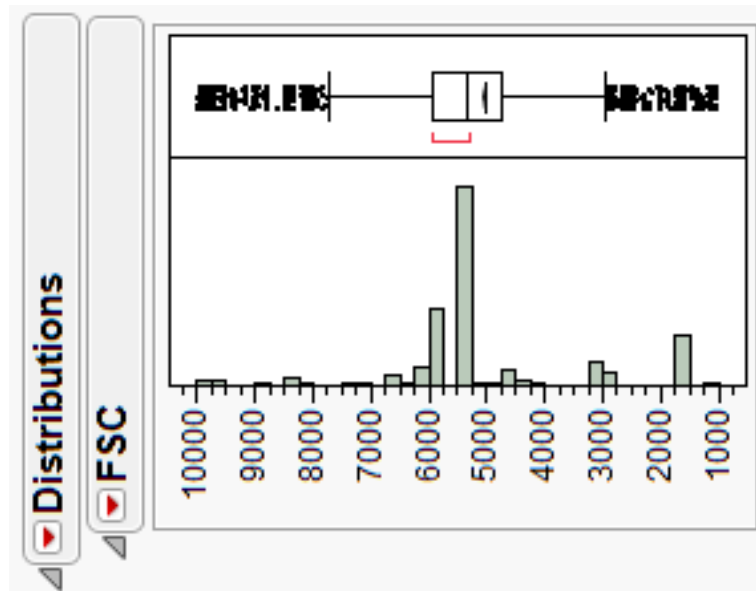


Figure 4.15 Summary of multivariate regression model JMP® V9

Finally, Figure 4.16 is a histogram of the Federal Supply Classification where it is easy to see which classes are more frequently purchased for the AAF from 1994 to 2012.



**Figure 4.16 The Federal Supply Classification histogram**

In this chapter, we present the results that the study arrived at by analyzing three aspects of the procurement system: process characteristics, time in the system, and correlation analysis. These results follow from the methodology explained in Chapter III. In Chapter V, we proceed to draw some conclusions and discuss the results we present here.

## **V. Discussion and Conclusions**

The previous chapter displayed various AAF's statistics with respect to procuring defense articles under the FMS system from 1994 to August 2012. In this chapter we discuss the insights of the results and obtain conclusions and answers to the research questions which drove this investigation. We discuss the results in order as presented in the previous chapter. Finally future study opportunities and recommendations will be presented.

### **Process Characteristics Analysis**

Regarding the characteristics of the procurements, we can say that the AAF has purchased more articles from the USAF Services; 66% of the acquisitions come from the U.S. Air Force system. During this time period 1994 – 2009, 78% of the processes were successfully completed. Also and not considering all the acquisitions that were cancelled by the customer, the AAF received an orders fill rate of about 92% of the time from the U.S Services. In particular, 22,834 orders were completed 100%.

Moreover, 68% of the acquisitions were considered as Standard, and more than 85% of these acquisitions were successes. Otherwise 27% were considered Non Standard with a success rate of 55%. The 5% remainders are procedures with a codification other than Standard or Non Standard codes. AAF only received 132 back order or delay notices during this period of time and from this more than 80% resulted in successful purchases.

Regarding the cancellations or rejections it was possible to determine from the codes reasons what occurred more frequently. The second and third main causes with codes BQ (14%) and CG (14%) are cancellations from the requisitioner and rejections because it was impossible to identify the component respectively; also the code CJ (8%) is relevant corresponding to obsolete or inactive articles. Otherwise, the major component of rejections have the CA (28% 1,464 orders) code where the specific explanation lies within each narrative. Of the cancellations, 24% could be attributable to a supplier, 48% to the customer, and the rest to CA code. Also if we see the evolution of the cancellations across the years relative to the total purchases initiated during this period, we notice a slightly increasing tendency.

### **Time in the system**

Regarding the time that the purchase takes from initial order to delivery at the warehouse, it possible to say that both the Standard and Non Standard procedures have a skewed distribution. However, their median values don't differ too much, 321 days and 371 days respectively. Taking in to consideration performance across the Services (median values), the USAF has a little quicker response for Standard articles than the others, 57 % faster than the NAVY and 35% than the ARMY. Meanwhile, for Non standard articles the ARMY is quicker 33% faster than the USAF and 25% than the NAVY.

### **Regressions**

Considering the independent variables that may affect the time in the system like the country priority, Federal Supply Classification, type of service, and type of

acquisition the regression shows that these regressors do not produce a real impact in the system time. The correlation coefficient is never larger than 0.4 for any case in a multivariate pairwise comparison. In particular for a multivariate regression model with all these variables the total  $R^2$  value is 0.169, essentially a non-significant effect.

However, from the histogram about FSC is it possible to arrive at a solid conclusion. It is very significant which class of component the AAF purchases more frequently. From the DLA H2 Handbook Manual 2003 they correspond to the 50XX Group, which includes Hand and Measuring tools, Hardware and Abrasives, Communication and Detection equipment, and Electrical and Electronic components among others. It is a clear indication about which kind of component the AAF has more dependency from a foreign supplier like FMS.

With all the previous results and explanations, the study turns to answering the research and supplementary questions.

1) What are the main factors that historically affect the procurement processes under the FMS system with respect to the AAF?

According to the study we can see that the main factors that may affect the AAF's procurements are: the level of cancellations/rejections produced by the customer himself, the inability of FMS to identify the requirement (specifications), and the obsolescence/inactive articles requirements. This the last one is a consequence of the older AAF fleet (about 30 years).

Also, despite the training that the FMS participants receive previous to their deployment and because of the complexity of the FMS system, it may be have to assign permanent people with “deep knowledge” of the system, which in conjunction with increased decision authority by the FLO could contribute to the clarity of purchases.

2) What are the characteristics of the procurements, such as, supply services, success procedures, and type of acquisition, cancellations reasons, and time in the system?

We can list the following characteristics during this period:

- a) USAF Services has been the main supplier and with a faster response in comparison with the other U.S. Services for Standard procurements. The ARMY seems faster for Non Standard purchases.
- b) 78% of the processes were successfully completed.
- c) AAF received about 92% orders fill rate from the U.S. Services.
- d) 22,834 orders were completed 100%.
- e) 68% of acquisitions were considered Standard. More than 85 % of these were success procurements.
- f) 27% of acquisitions were considered Non Standard. 55% were success procurements.
- g) 132 purchases received a back order code action. More than 80% were success procurements.
- h) Status codes CA, BQ, CG, and CJ are the main reasons for cancellations/rejections.



- i) For both type of procurement Standard and Non Standard the median time in the system is averaging a year.
- 3) What types of correlations are present that influence the procurement time?

Despite what common sense may indicate, neither the type of the defense article (FSC) nor the type of procurement Standard or Non Standard or the U.S. Service supplier have a real influence in the time of the system (pipeline time); only the country priority present a slight decrease of linear association with Delta Dates.

- 4) What corrective actions can be applied that improve the acquisition process?

According to the analysis we may address these corrective actions:

- a) Reduce as much as possible the AAF's cancellations/rejections by its own decision.
- b) Assure the availability of the most updated specification data (catalogs) in order to reduce the cancellations/rejections level because of the inability of FMS to identify the articles.
- c) Sustain and improve the skills of the FMS system operators/managers by performing continual training.
- d) Assure the best level of communication in order to reduce the obsolete inactive articles requirements.
- e) Review and assign the right level of decision authority to the FLO in order to reduce procurement times with respect to routine actions.

## **Future studies**

Being the first historical review of the AAF purchases under the FMS there is opportunity for future studies, such as discerning the CA cancellations code from the narratives, which is very tedious and time consuming because of the burdensome computer system. However doing so, may discover a new reason for these cancellations. Addressing this reason might further facilitate the management of the acquisition system.

## **Recommendations**

Considering that delays or extra-costs are undesirable, we can draw two main recommendations as result from this research:

- a) Since the second and third main factors resulting in cancellations and rejections involved failure to identify the element (CG) or AAF cancelled the request (BQ), the AAF should improve the skills of the operators of the system. This could involve more training or implementing an extra control (data entry errors) over the requisition procedure until a certain level of quality control can be reached. Additionally, verify that the personnel are working with the most update information about specification data (catalogs). In particular for the AAF, cancelled requests may result in a requisition planning review. For the fourth main factor, which involves an obsolete or inactive item (CJ), the AAF should review the communications channels with the FMS system in order to not request an item in this condition.

- b) Review the routine decision authority level for the FLO that will allow, more local decisions instead of headquarter approval. This would avoid unnecessary delays and possible cost.

Those are not the only actions that the AAF could take but for sure they will improve the performance of the system because they have a direct relation with time consuming and extra monetary issues.

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## **Vita**

LtCol. Juan E Perot graduated with honors from Argentina Air Force Academy, Córdoba, República Argentina in December 1991. He entered undergraduate studies at the Institute University of Aeronautic, Córdoba, República Argentina where he graduated with a Mechanical Aeronautic Engineering degree in December 1995. He graduated with honors from the Air Warfare School, Argentina Air Force as Joint Staff Officer in December 2007, and he also participated in several professional courses, congress and conferences. He also entered graduate studies at El Salvador University, Buenos Aires, República Argentina where he graduated with a Master Business and Administration degree in December 2010.

His first assignment was at V Air Base, San Luis as Maintenance Officer in January 1996. In January 2002, he was assigned to the Area de Material Río Cuarto Depot Maintenance Base, Córdoba, where he served as a Depot Maintenance Officer. From January 2006 to December 2007 he was assigned as student in the Air Warfare School, Buenos Aires. In January 2008 as a Major, he was assigned to the Argentina Air Force Headquarter, Material Command and served as Auxiliary in the Technical Training Department. In January 2009 he deployed overseas to Cyprus under United Nations Mandate as Peacekeeper, Second in Command of the UNFLIGHT, and Maintenance Officer in UNFICYP. In 2010 he was assigned to Material Command as Maintenance Budget Controller. In September 2011, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be return to the Material Command Argentina Air Force.

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